DOCUMENT RESUME

ED 228 148 SO 014 626

TITLE Global 2000 Countdown Kit.
INSTITUTION Zero Population Growth, Inc., Washington, D.C.
PUB DATE May 82
NOTE 126p.; Some charts may not reproduce clearly in microfiche.
AVAILABLE FROM Zero Population Growth, Inc., 1346 Connecticut Avenue, N.W., Washington, DC 20036 ($15.00).
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Agriculture; Air Pollution; *Conservation (Environment); Energy; *Environmental Education; *Global Approach; High Schools; Hunger; Income; Learning Activities; *Natural Resources; *Population Education; Social Studies; Units of Study; Water Resources; World Problems

ABSTRACT

Fourteen units for high school global education classes are based on "The Global 2000 Report to the President," which examines the relationships between worldwide population growth and resource and environmental consequences. Topics of the units are population; income; food; fisheries; forests; water; nonfuel minerals; energy; impacts on agriculture, water resources, forest losses, and the world's atmosphere and climate; nuclear energy; and species extinction. Each unit includes a narrative that describes the primary issue covered; an activity or problem that students complete, usually within the confines of the classroom or library; and activities consisting of games, debates, and research projects. The final section of each unit suggests specific ways that students can make a difference in the environment when they participate in family, school, and community action programs which are designed to effect change. For example, students can make a difference when they try to save water in their everyday life and when they test water from a local lake for acid rain problems. The accompanying teacher overview includes methods for introducing and using the materials and a chart describing learning objectives, skills, subject links to other topics, and teacher tips. Audiovisual and printed materials are available from the publisher. (KC)

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GLOBAL 2000 COUNTDOWN KIT

May, 1982

Zero Population Growth, Inc.
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1346 Connecticut Avenue, N.W.
Washington, DC 20036

SP 014 426

The ultimate goal of all our efforts is to help our society make informed choices today to assure a better and more sustainable world tomorrow.

-Russell W. Peterson,
Chair of the Board of
Directors of the Global
Tomorrow Coalition

Zero Population Growth is a national non-profit membership organization that works to mobilize broad public support for population stabilization in the U.S. and worldwide.

Teacher Overview

At the desk where I sit I have learned one great truth. The answer for all our national problems—the answer for all the problems of the world—comes to a single word. That word is "education."

—Lyndon B. Johnson

Introduction to the Materials

According to the *Global 2000 Report to the President*, "If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now."

The Report presents a sobering and perhaps alarming analysis of future trends. However, as it does so, it provides a wealth of clearly stated and carefully analyzed data that lends itself to a variety of educational activities. Zero Population Growth (ZPG) felt that the release of this document provided an opportunity to help students understand the importance of paying attention to population-related concerns and becoming involved in action to protect our planet. Commissioned by President Carter and published in 1980, *The Global 2000 Report* was the largest and most intensive study of its kind ever undertaken at top government levels. The Departments of State, Interior, Energy, and Agriculture along with nine other government agencies combined their expertise and resources in preparing the Report. The two year study resulted in a three volume document which attempts to project what the Earth will be like in the year 2000 if present trends continue.

Using the Materials

The *Global 2000 Report* is over 760 pages long and analyzes 14 different topics. In preparing the *Global 2000 Countdown Kit*, it quickly became apparent that materials which attempted to cover all aspects of the Report in great depth were not possible. Instead ZPG decided to prepare an activity focusing on one aspect of each of the 14 topics covered in the Report. In this way the 14 activities taken as a whole would provide insight into most major aspects covered in the Report. In addition since many of the topics are interrelated, it was possible to design activities that reinforce each other while still permitting their use independently. Each unit includes a narrative of the problem and a classroom activity. A final section titled "Making a Difference" describes community actions the students can take to help improve the situations noted in the unit. The end objective, of course, is to encourage the students to become effective and active citizens, shaping the course of their lives and the world they live in.

Independence and flexibility are key features of these materials. Each unit is intended to be used directly by the students with minimal supervision from you, the teacher. The materials are designed for high school, but can be modified for lower grades. The kit may be used with various members of the class assigned to each topic so that by sharing the results from all units, the class will understand the main ideas of the Report. Alternatively, individual units may be used to supplement the established curriculum throughout the year. The units can also be used as independent study topics for advanced students or as extra credit projects for any class member.

The chart on the back of this Overview will allow you to plan the best way to use these materials. By analyzing the topics, subject areas covered, skills employed, and unit objectives you can match the kit's use to your class' needs. The chart also gives you some idea of how much assistance you will need to give students as they work through a unit. Of course, the amount of assistance necessary will vary with the enthusiasm, ability, and grade level of the students.

A list of general Teaching Aids is provided in this Overview and Learning Aids for students are listed in each activity. You may wish to order these early in the school year and set up a "resource corner" for student use. A list of vocabulary words is also provided. This glossary page may be reproduced and given to all students working with the materials. The first time a vocabulary word is used in any unit it appears in bold type to let students know that the glossary page should be consulted. Definitions used are simplified, working definitions tailored to the context of the *Global 2000 Countdown Kit*.

As an introduction to the materials, all students should read the Student Overview, and you should discuss it briefly with them. This summary will serve to orient the students to the content and scope of the *Global 2000 Report*. It will also allow students to select topics of particular interest to them if they will be working on one or a few units independently.

A second way to introduce the class to the materials is through the use of a general model showing how the topics covered in the 14 units are interrelated. The model on page three of the Overview can be reproduced and given to each student, or the model can be drawn on the board. Have a student pick one of the units at random and explain what affect the topic covered in that unit would have on another topic. Draw a line between these topics and write the relationship along the line. Continue with the discussion, having the students suggest other relationships between topics. (A sample of the chart showing how the food topic is related to other topics is partially illustrated on page four.) After completing this chart students should understand some of the basic issues involved in the *Global 2000 Report* and begin to see how they are inextricably linked.

Teaching Aids

1. AUDIO/VISUAL AIDS

The Global 2000 Report. A slide/audiotape program. Produced and distributed by Christensen Associates, Suite 2000, Chapel North Building, 62 North Chapel Street, Newark, DE 19711. Color; 27 min. 1981.

Science and Mankind, Inc. A slide/audiotape series. Distributed by Center for Humanities, Inc., Two Holland Avenue, White Plains, NY 10603. Color; each approximately 30 min.

- *Biological Catastrophies: When Nature Becomes Unbalanced*. 1976.
- *Critical Issues in Science and Society: A World to Feed*. 1976.
- *Critical Issues in Science and Society: The Great Energy Debate*. 1976.
- *Man and Environment: In Harmony and in Conflict*. 1971.
- *Science and Ethics of Population Control: An Overburdened Earth*. 1975.

Terra: Our World. An instructional television series. Maryland Instructional Television, Maryland State Department of Education, Maryland Center for Public Broadcasting, Owings Mill, MD 21117, 1981. Color; each 20 min.

Terra: Our World series

- *Environments*
- *Places Where People Live*
- *Renewable Resources*
- *Non-Renewable Resources*
- *Energy*
- *Energy Alternatives*
- *Food in the Environment*
- *Food and People*
- *Quality of Life*
- *The Future*

2. PRINTED AIDS

Building a Sustainable Society, Lester R. Brown. W.W. Norton and Co., NY, 1981.

Ecoscience: Population, Resources, and Environment, 3rd ed., Paul Ehrlich, Anne Ehrlich, and John P. Holden. W.H. Freeman and Co., San Francisco, 1977.

Energy, Resources and Environment, John W. Christensen. Kendall/Hunt Publishing Co., Dubuque, IA, 1981.

Environmental Quality Index (issued annually). National Wildlife Federation, Washington, DC. Single copies free.

The Global 2000 Report to the President: Entering the Twenty-first Century, Vol. 1, Summary Report. Government Printing Office, Washington, DC, 1980.

Worldwatch Papers. Worldwatch Institute, Washington, DC, 1975-present. A collection of over 40 monographs dealing with population, resources, and the environment.

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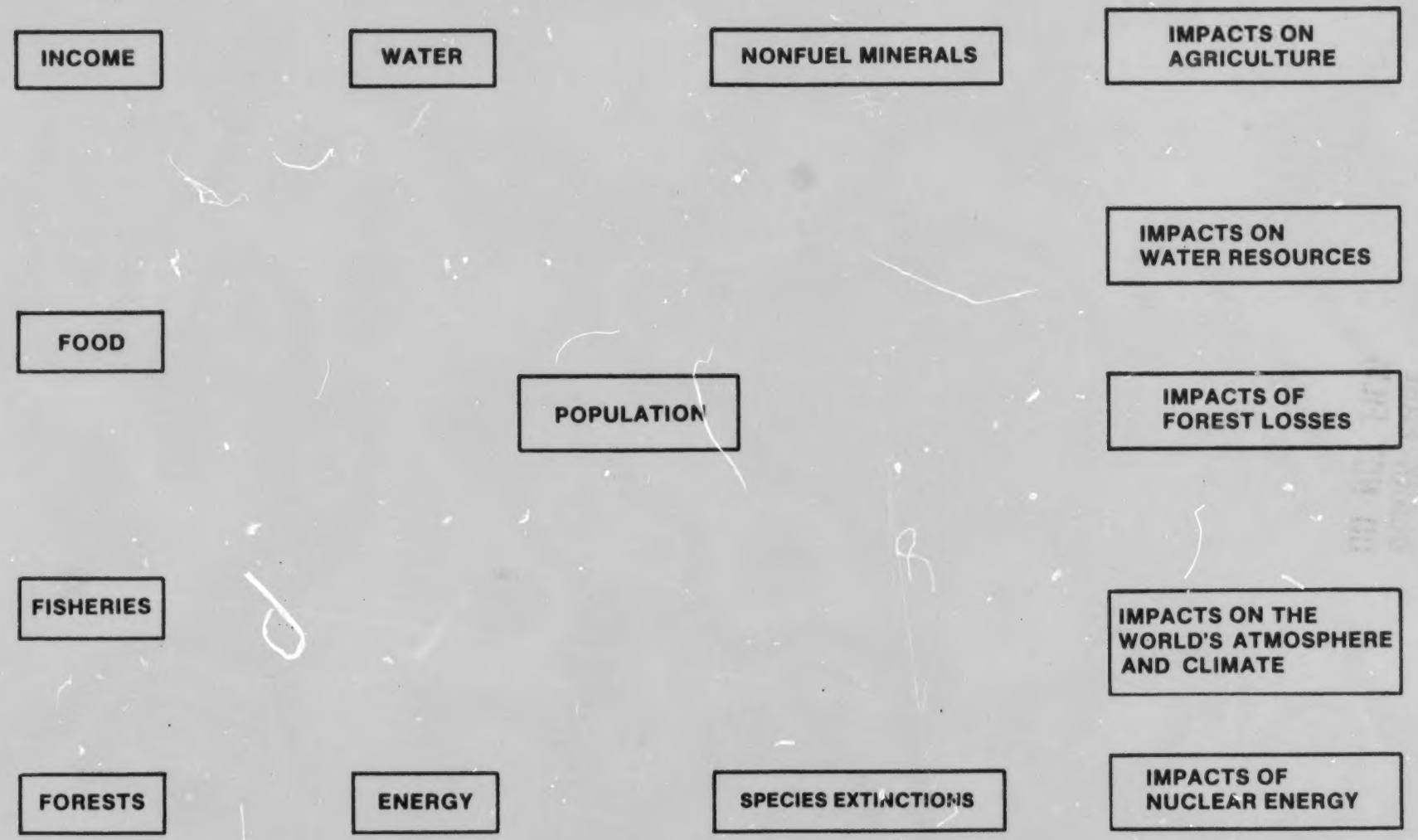
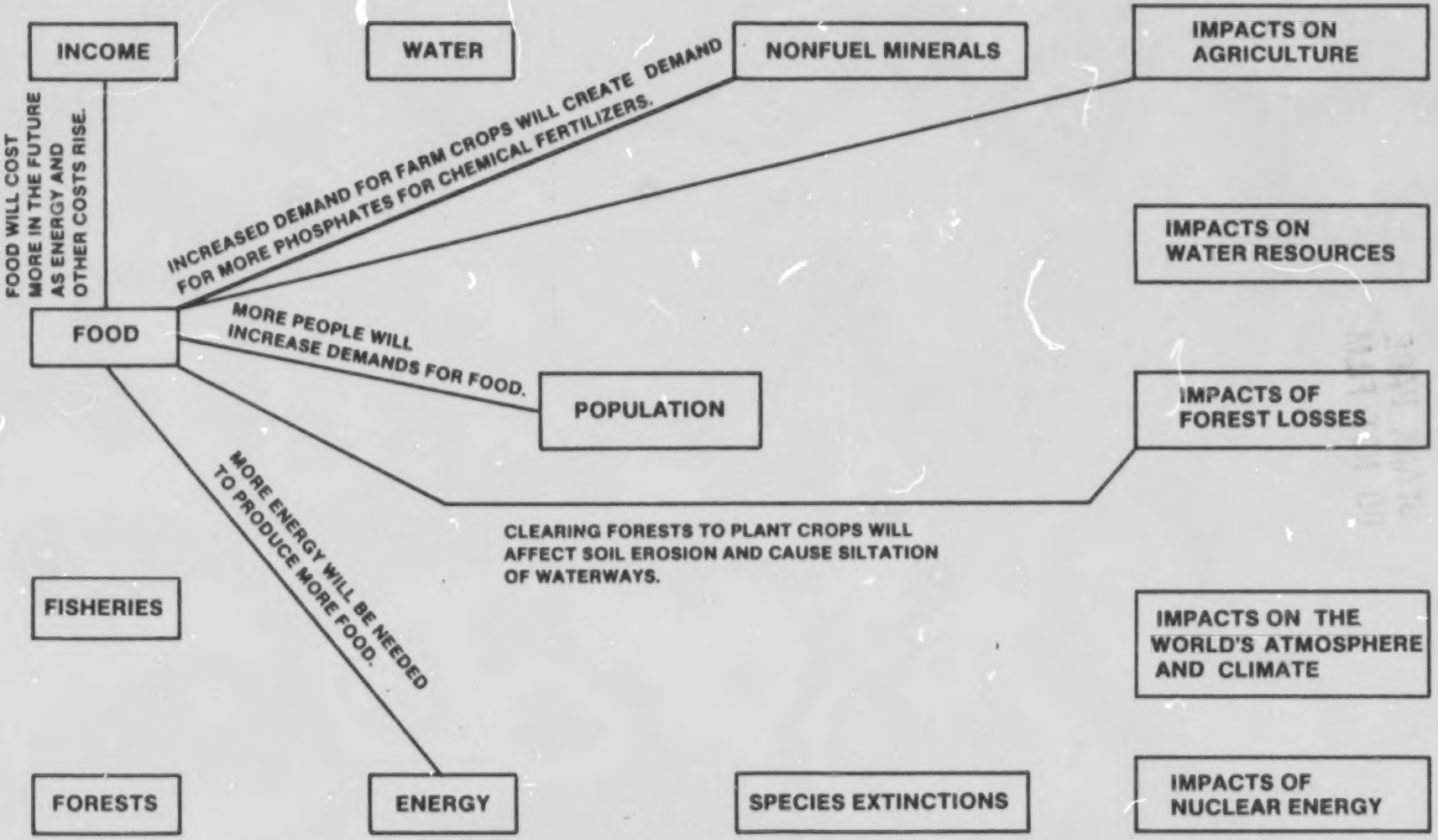
GENERAL MODEL



FOOD


INCOME
WATER
NONFUEL MINERALS
IMPACTS ON AGRICULTURE
FOOD WILL COST MORE IN THE FUTURE AS ENERGY AND OTHER COSTS RISE.
INCREASED DEMAND FOR FARM CROPS WILL CREATE DEMAND FOR MORE PHOSPHATES FOR CHEMICAL FERTILIZERS.
IMPACTS ON WATER RESOURCES
FOOD
MORE PEOPLE WILL INCREASE DEMANDS FOR FOOD.
POPULATION
IMPACTS OF FOREST LOSSES
CLEARING FORESTS TO PLANT CROPS WILL AFFECT SOIL EROSION AND CAUSE SILTATION OF WATERWAYS.
MORE ENERGY WILL BE NEEDED TO PRODUCE MORE FOOD.
FISHERIES
IMPACTS ON THE WORLD'S ATMOSPHERE AND CLIMATE
FORESTS
ENERGY
SPECIES EXTINCTIONS
IMPACTS OF NUCLEAR ENERGY

This sample illustrates some relationships "Food" has with the other topics. The chart is partially complete to give you an idea of how this activity can be conducted. Links among the other topics could be shown in a similar manner.

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TITLES, GLOBAL 2000 TOPICS, & DESCRIPTIONS	LEARNING OBJECTIVES After completing the respective activities, the students will be able to:	SKILLS (a), SUBJECTS (b), & LINKS TO OTHER REPORT TOPICS (c)	TEACHER TIPS
1. The People Connection (Population). Students learn about population by contrasting growth of a developed country and a less developed country. Future populations are calculated based on present populations and growth rates.	a. Calculate future population levels given the growth rate and present population level. b. List two impacts migration of rural people to cities might have on the city environment.	a. Graphing, collecting data, polling opinions b. Math, social studies, biology, language arts c. All other topics of the Report	This unit suggests a visit with your city planner. If your city or town does not have anyone who serves this function, check at the county or regional level to secure a speaker. Also be prepared to write several statements on the board as listed in "Making a Difference."
2. The Lion's Share (Income). Students study the relationship between income and family size as an aid to seeing how a country's per capita income varies with its population and gross national product.	a. State the general relationship between population growth and per capita income. b. Calculate the average per capita income given total population and gross national product.	a. Analysis of data, research and preparation of a budget b. Math, economics, social studies c. Population, Food, Impacts on Agriculture, Energy, Nonfuel Minerals	Have newspapers on hand to which students can refer. The newspapers should include classified ad sections (employment, housing, automobiles) and grocery ads.
3. Food for the Future (Food). Students engage in a competition which allows them to propose ways to improve agricultural productivity.	a. Define the term "Green Revolution." b. State three methods of increasing food production; compare and contrast advantages and disadvantages of each.	a. Library research, field investigations, debate/public speaking, writing b. Math, home economics, social studies c. Population, Income, Water, Energy, Impacts on Agriculture, Fisheries, Impacts on the World's Atmosphere and Climate, Impacts of Forest Losses	Help students organize themselves into teams of farmers and a panel of judges. You may wish to be on the judging panel. Be prepared to facilitate a discussion that will lead to a consensus in "Making a Difference."
4. Ode to a Fish (Fisheries). Students survey literature dealing with fish and marine products in order to learn how important fisheries resources are in their lives.	a. List four major uses for fish and marine products. b. State the current trend in the annual catch of fish and analyze its implications for per capita protein consumption in the future.	a. Library research, field investigations, public speaking, debate, writing b. Language arts, biology, home economics c. Population, Food, Water, Impacts on Water Resources, Impacts on the World's Atmosphere and Climate, Species Extinctions	You may be called upon to help organize a debate and a consumer hike.
5. "BTUs" - Better Timber Uses (Forests). Students learn about the importance and variety of uses for forests and calculate the energy content of various fuels.	a. Contrast the major uses for wood in less developed countries and developed countries. b. List three consequences of deforestation.	a. Library research b. Math, biology, physics, social studies c. Population, Energy, Income, Species Extinctions, Water, Fisheries, Impacts of Forest Losses	Students may need assistance identifying specific community groups interested in timber conservation. They may also require assistance in starting and operating a paper recycling center.
6. Roll on Mighty River (Water). Students participate in a simulation game to determine problems associated with water quality and distribution.	a. List three water conservation measures that could be taken in everyday life. b. State three competing uses for water and recommend solutions of water allocation problems that might occur because of these uses.	a. Public speaking/debate, library research, game strategy b. Geography, language arts, social studies, earth science c. Population, Fisheries, Food, Impacts on Agriculture	Help students conduct a simulation activity. Assist in designing a water conservation plan.
7. Far Never More (Nonfuel Minerals). Students locate source and recipient countries of nonfuel minerals and illustrate the relationships and dependencies created.	a. Locate the major country of origin for three nonfuel minerals and major importing countries of those minerals. b. Describe two conditions that could lead to a disruption in the supply of nonfuel minerals and two possible outcomes of the disruption.	a. Mapping, library research, chart construction b. Geography, earth science, social studies, political science c. Population, Income, Energy	Materials are needed: wall map of the world, yarn of several different colors, if possible; three by five inch index cards; pins. For an optional activity: poker chips or colored tokens (three colors in equal amounts), large indoor or outdoor area (gymnasium would be good). You will help organize and officiate the game. You may also help students start a recycling center.
8. Where Do You Get All Your Energy? (Energy). Students contrast the lifestyles of teenagers in two different cultures and analyze types and amounts of energy use.	a. List two problems associated with energy use in developed countries and in less developed countries. b. State feelings about the following statement: Daily life in India is better than in the United States because Indians use less energy and have a simpler lifestyle.	a. Information analysis, decision-making b. Geography, social studies c. Population, Impacts of Nuclear Energy, Income, Forests, Species Extinctions, Food	Showing a film on India and its peoples would help enrich this activity. Help students conduct an energy audit of the school.
9. Agriculture: Is Any Culture Left? (Impacts on Agriculture). Students analyze various problems facing modern agriculture and then propose solutions.	a. List at least two factors which contribute to loss of productivity on agricultural lands. b. Write a paragraph explaining feelings about the conversion of farmland to housing subdivisions, shopping centers, or other developments.	a. Library research b. Science, social studies c. Population, Species Extinctions, Food, Impacts on the World's Atmosphere and Climate, Impacts of Forest Losses, Water, Energy, Income	Help students organize an organic gardening plot or a community gardening plan.
10. Go With the Flow (Impacts on Water Resources). Students play a board game to learn about the history of water use and about some modern water-related issues.	a. Differentiate between consumptive and nonconsumptive uses of water. b. Define the term "waterborne disease" and list at least two such diseases.	a. Historical analysis, game strategy b. Biology, history c. Population, Impacts on Water Resources, Fisheries, Impacts on Agriculture, Impacts on the World's Atmosphere and Climate	Students may require assistance with an audit of home water use. Photocopy components of the WATER RESOURCES GAME. A die is needed for the game. It may also be desirable to enlarge the game board on a poster board (approximately 20" x 30").
11. Photo Forest (Impacts of Forest Losses). Students study satellite photos to record the loss of forest land in an area.	a. State two effects on soils that may result from clearing large forest areas. b. List three soil conservation techniques that can be used to limit erosion at construction sites.	a. Photo analysis, report writing, investigative reporting b. Geography, language arts, social studies c. Population, Species Extinctions, Water, Energy, Fisheries, Impacts on the World's Atmosphere and Climate, Impacts on Agriculture	The Landsat map is a simplified version of a Landsat photo showing the lower Amazon River and river delta. Jari is shown as a white space. In "Making a Difference," students will be dealing with a developer. Help the students cultivate and preserve good relations with the developer. It is key to the success of the activity.
12. Build a Better Smokestack (Impacts on the World's Atmosphere and Climate). Students put on different "hats" to present their perspectives of a hypothetical acid rain problem to the mayor of their city.	a. Analyze data and predict the origin of acid rain in a hypothetical case. b. List two effects of acid rain on aquatic ecosystems.	a. Political action, game strategy, public speaking, data synthesis and analysis b. Language arts, earth science c. Population, Fisheries, Food, Energy, Impacts on Agriculture	Help facilitate a simulation activity. For water testing, the Hach Company in Ames, Iowa makes excellent kits. (Note: Litmus paper will give a general test of pH but may not be specific enough to be useful in this activity.)
13. New Clear Reactions (Impacts of Nuclear Energy). Students participate in a board game to learn facts and concepts about nuclear energy use.	a. List two arguments for and two arguments against the following statement: Nuclear energy should be a major source of electricity in the year 2000. b. List two positive and two negative aspects of building a nuclear power plant in a community.	a. Game strategy, library research, questionnaire development b. Physics, social studies c. Population, Energy, Income, Impacts on the World's Atmosphere and Climate	See materials list in activity section. Students may be taking surveys in public areas. Be certain that they obtain permission to survey, if needed.
14. Bye Bye Birdie (Species Extinctions). Students set criteria to judge the "value" of a species and apply these criteria to determine which of eight endangered species should be saved.	a. Give three arguments that might be used to justify preservation of a species. b. Write a paragraph expressing feelings about the possible extinction of one of the species in this activity.	a. Development of priorities, public speaking, analysis of conflicting data, decision-making b. Biology, social studies, economics c. Population, Impacts of Forest Losses, Impacts on Agriculture, Water, Fisheries	Facilitate a simulation activity.

Glossary

Acid Rain - Rain, snow, or other precipitation which is more acid than normal because of pollution resulting from gases such as sulfur dioxide.

Acre Foot - The volume of water that will cover an acre to a depth of one foot (43,560 cubic feet).

Agricultural Run-off - Water which runs off farm fields after rains. Such water is frequently high in pesticides, other chemicals, and silt.

Animal Dung - Usually the manure of grass-eating animals.

Baby Boom - A period from the late 1940s to the early 1960s when families with three to four children were the average.

Birth Rate - The number of babies born in a given year per 1000 individuals in the population.

Breeder Reactor - A nuclear reactor which can produce more atomic fuel than it uses.

British Thermal Unit (BTU) - The amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit. A common measure of heat or energy.

Crop Waste - The plant material left after the main crop is harvested. Corn stalks and beet tops are examples.

Death Rate - The number of people who die in a given year per 1000 individuals in the population.

Deforestation - Removing large blocks of trees; clearing whole forests.

Desalinization - Removing salt from water to purify it.

Developed Countries (DCs) - Countries having a high standard of living with extensive use of natural resources and many industries.

Energy-Intensive - An activity or industry which uses large amounts of energy.

Erosion - The wearing away of soil, particularly by water and wind.

Exponential Growth - A rate of growth that occurs when a quantity is multiplied by a specific rate and the product is added to the original quantity. Populations grow exponentially, and that growth is very rapid. 1, 2, 4, 8, 16, 32 . . .

Extinction - The condition in which a type of plant or animal no longer exists in living form.

Fish Meal - Ground, dried fish. Usually small fish which cannot easily be cleaned and packaged for human consumption are used.

Fish Oil - The oil pressed from fish in the preparation of fish meal.

Flow Restricter - A washer or other device placed in a shower nozzle to limit the water that can flow through.

Fuel Minerals - Minerals which will burn and can be used as fuel—oil, gas, coal.

Green Revolution - A change in agricultural techniques which occurred in the mid 1950s through early 1970s, during which plant breeders were able to develop new strains of plants producing extremely high yields. These new strains, combined with improved farming techniques, brought about a revolution in modern agriculture.

Gross National Product (GNP) - The total monetary value of all goods and services produced by a country.

Growth Rate - The percent by which a population increases each year.

Habitat - The place where a plant or animal lives that supplies it with food, shelter, and water.

Hectare - A metric unit roughly equal to 2.5 acres or 108,000 square feet.

Herbicide - A chemical used to kill weeds.

Industrial Revolution - A period beginning about 1750, when machines were invented in Europe which could do the work of many people. This switch from slow, inefficient human power to fast, cheap machine power was in full swing in the eastern United States by 1850.

Irrigation - Using pipes, ditches, pumps, etc. to supply dry land with water.

Less Developed Countries (LDCs) - Those countries with little industry and low use of most natural resources, also called developing countries.

Malnourished - Suffering from the wrong kind or lack of food.

Net Migration - The migration from a country subtracted from the migration into a country.

Nonfuel Minerals - Minerals which will not burn and are not used as fuel—iron, tin, silver, etc.

Nutrient Recycling - The process by which chemicals such as nitrogen and potassium are continually reused by plants and animals in nature.

Ozone Layer - A layer of gas in the upper atmosphere of the Earth. Ozone filters out some ultraviolet radiation from the sun.

Per Capita - Per person, for each individual.

Pesticide - A chemical used to kill insects and other pests.

pH - The measure of the acid content of something. A pH lower than seven means that the material is acidic.

Plaintiff - The party who files a suit in court.

Projection - An attempt to predict what the future will be, based on present conditions and current trends.

Radioactive Waste - Waste material from nuclear power plants or from the production of nuclear fuel or bombs.

Reforestation - The planting of trees to recreate a forest.

Scrimshaw - Ivory such as whale teeth or walrus tusks that has been etched with intricate designs.

Sedimentation - The settling out of materials such as silt and sand to form mud at the bottom of lakes and reservoirs.

Siltation - The settling out of fine dirt called silt. The silt is carried into the water by erosion and settles in quiet water such as lakes and reservoirs.

Stabilization - The point at which a country's population remains constant, i.e. births plus immigration equals deaths plus emigration.

Strip Mining - A method of extracting minerals such as coal where the surface soil is stripped off so that the underlying mineral can be mined.

Toxic Salts - Chemical compounds found naturally in most soils. Harmless in small amounts, but harmful to plants in larger amounts.

Waterborne Diseases - Illness caused or transmitted by organisms living in water.

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Student Overview

The Report and Its Importance

According to the *Global 2000 Report to the President*, "If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now."

What is the *Global 2000 Report*? Authorized by President Carter and published in 1980, this Report was the most comprehensive study of its kind undertaken by the U.S. government. Thirteen government agencies including the Departments of State, Interior, Energy, and Agriculture combined their expertise and resources in the effort. The two-year study developed **projections** of what the Earth could be like in the year 2000 based on present conditions and trends.

Fourteen topics were identified and addressed in the Report:

1. Population
2. Income
3. Food
4. Fisheries
5. Forests
6. Water
7. Nonfuel Minerals
8. Energy
9. Impacts on Agriculture
10. Impacts on Water Resources
11. Impacts of Forest Losses
12. Impacts on the World's Atmosphere and Climate
13. Impacts of Nuclear Energy
14. Species Extinctions

This educational kit follows a similar structure with an individual unit devoted to each of the fourteen topics addressed in the Report. Because reams of information have been written about these topics, we limited our scope to some of the more basic information about each.

While you may not be able to study each unit in detail yourself, you may wish to divide the topics among your classmates. Later you can share your findings and recommendations. This process should enable you and your classmates to develop an overall understanding of the trends highlighted in the *Global 2000 Report*. Your teacher will help get you started and suggest additional learning aids and avenues of study as you proceed. Throughout the kit, words in bold type are defined in the Glossary.

Interrelationships

Any arrangement of such broad topic areas is necessarily artificial. How can you separate the "Impacts of Forest Losses" topic from the "Species Extinctions" topic, when clearing of tropical forests is one of the major causes of species extinctions in the world today? On an even broader scale, population change affects or is affected by every other topic discussed in the *Global 2000 Report*.

Nevertheless, even though the topic divisions may be arbitrary, they provide a convenient system for organizing the many facts and concepts in the Report. As you complete each activity in the kit, keep in mind that changes in one area have tremendous implications for other areas as well.

Solutions

The purpose of the *Global 2000 Report* was not to provide solutions. Instead, the Report notes current trends and projects these trends to the year 2000. The units in this kit do not provide solutions either. Instead, they offer situations to explore and opportunities to propose alternatives. The year 2000 is not far away. The thoughts and ideas you develop now may be part of the overall effort needed to ensure a livable environment for you and future generations.

Major Findings of the Report

It was impossible to include all the pertinent points contained in the Report in our 14 individual units. Therefore, in order to give you a more comprehensive view, we have provided the following list of key findings from each of the topic areas.

Population

- Enormous growth in world population is expected by the year 2000. The lowest growth assumption shows the world topping six billion in 2000, compared with the four billion present in 1975.
- Most of this population growth (92 percent) will occur in **less developed countries (LDCs).**
- In addition to rapid growth, the LDCs will experience dramatic movements of rural population into the cities and increasing demands for jobs, housing, resources, and social services.

Income

- The **gross national product (GNP),** a rough measure of social and economic welfare, is projected to increase worldwide by 145 percent from 1975 to 2000.
- This growth in GNP will largely be offset by population growth. Each person's average share of the GNP will not increase greatly during this period.
- Present income differences between the wealthiest and poorest nations are projected to widen.
- On the whole, income in LDCs is projected to grow more dramatically than in **developed countries (DCs).** However, this growth will not meet the needs of the majority of the population.

Food

- Assuming no deterioration in climate or weather occurs, food production is projected to be 90 percent higher in 2000 than in 1970.
- Most of this increase will result from **energy-intensive** farming methods such as increased use of fertilizers, **pesticides, herbicides,** and **irrigation.**
- In the early 1970s, one **hectare** of farmable land supported an average of 2.6 people. By 2000 one hectare will support four people.
- In the LDCs, rising food output will barely keep ahead of population growth.
- The United States is expected to continue its role as the world's principal food exporter.
- The number of **malnourished** people in LDCs could rise from approximately 500 million today to 1.3 billion people in 2000.

Fisheries

- The world harvest of fish is expected to rise little, if at all, by the year 2000.
- Some potential for greater marine harvests comes from fish farming and harvest of nontraditional marine species.
- Fish will continue to be a significant source of protein, but population growth will lower the **per capita** amount of protein supplied by fish (and other sources) by the year 2000.
- More than one-third of the fish harvest is presently used for animal food and non-food products, not food for people.

Nonfuel Minerals

- The global demand for **nonfuel minerals** will double by 2000.
- Phosphate rock used for fertilizer will be in great demand.
- The industrial countries will continue to use three-fourths of the nonfuel minerals in 2000.
- Depletion of mineral deposits is not projected for the year 2000. However, the minerals that are most accessible and least expensive to mine will have been exhausted. Political instability in resource-rich countries will make many minerals unavailable.

Water

- By the year 2000, demands for water worldwide will increase by 200-300 percent.
- The largest cause of projected increased water use will be **irrigation.**
- Water used for irrigation is largely non-recoverable, making the cost of one-time use high. In addition, problems associated with irrigation make 125,000 hectares of land unfit for farming each year.
- Because irrigation is energy-intensive, increasing energy costs may curtail irrigation by 2000.
- Regional water shortages, present now, are likely to become more serious in many parts of the world by 2000.
- Population growth alone will double the demand for water (since 1971) in nearly half the countries of the world.

Forests

- Both forest cover and number of trees will decline 40 percent by the year 2000 in LDCs.
- Most of the loss will be in tropical forests.
- By 2020 virtually all accessible forests in the LDCs will have been cut.
- In LDCs 90 percent of wood goes for firewood and charcoal.

Energy

- The *Global 2000 Report* shows no early relief to world energy problems.
- The Report indicates that a transition from oil dependence is necessary but gives no formula for achieving independence.
- Because of increased population growth and industrialization (development), world energy demand is projected to increase 58 percent by 1990.
- Projections indicate that there is considerable potential for reduction of energy use and waste.
- **Per capita** energy consumption is projected to increase everywhere by the year 2000.
- Fuel wood—the poor person's oil—is expected to be less available in 2000 than it is today.
- Because of unavailability of wood and other fuels, an estimated 150-400 million tons of **animal dung** are burned for fuel annually, worldwide. This makes the dung unavailable for its important use in fertilization of soil.

Impacts on Agriculture

- The world's desert areas will expand almost 20 percent by 2000.
- About half of the world's irrigated lands have already been damaged by water-logging and buildup of **toxic salts.**
- Difficulties through the year 2000 include: soil **erosion**, loss of nutrients, compaction of soil, increased salt build-up in irrigated soils, loss of cropland to urban development, crop damage from air and water pollution, **extinction** of local and wild crop strains needed by plant breeders for improving cultivated crops, and more frequent and severe regional water shortages.

Impacts on Water Resources

- Quality of world water resources is virtually certain to suffer from the changes taking place between now and the year 2000.
- Water pollution in LDCs is likely to worsen as the urban population soars and industry expands.
- Health problems from **waterborne diseases** are likely to grow—particularly as irrigation projects are increased.
- All *Global 2000 Report* projections point to increasing destruction or pollution of coastal ecosystems, with a resulting decrease in food supply.

Impacts of Forest Losses

- **Deforestation** will lead to **siltation** of streams, of the reservoirs behind hydroelectric dams, and of irrigation works. Depletion of ground water, intensified flooding, and more severe water shortages during dry periods will also result.
- Forests will be reduced by one-half in south and southeast Asian mountains. Erosion from the cleared hillsides will harm fertile farmlands in the valleys below.

Impacts on the World's Atmosphere and Climate

- Further air pollution in LDCs and some industrial nations is virtually certain.
- Air quality is expected to decline from increased industrial growth in the next 20 years.
- More extensive burning of coal and oil will continue to make **acid rain** an increasingly serious problem.
- Carbon dioxide in the atmosphere is expected to increase one-third by the year 2000. This could bring a warming trend with serious affects on agriculture.
- The **ozone layer** in the atmosphere is being threatened by certain chemicals used in aerosol cans and refrigerants. A thinner ozone layer could lead to increased skin cancer.

Impacts of Nuclear Energy

- If nuclear power plants are built at the rate projected in the Report, nuclear reactor accidents will most likely increase. There will be a larger number of nuclear weapons and the potential for terrorist action will also increase.
- Disposal and storage of **radioactive waste** will continue to be a major problem.

Species Extinctions

- Up to 20 percent of all species on Earth could be extinct by year 2000 mainly because of **habitat** loss but also because of pollution.
- One-half to two-thirds of this extinction will occur because of the clearing of tropical forests.
- Extinction of species on this scale is without precedent in history.

It Doesn't Have to be This Way

The *Global 2000 Report* poses some critical challenges for us. If we are to continue to live an enjoyable and productive existence on this Earth, some major changes are required. Government policies must address these problems and produce creative solutions, but these policies will be carried out by people. Individual actions and altered lifestyles will be necessary to bring about this overhaul of values, ideas, and living standards. These changes must be initiated and implemented at all levels of society.

These units are designed to help you explore the issues highlighted in a report which has been hailed as one of the most important documents of our time. Through the effort and thought required to complete the units, we hope you will learn to analyze issues critically, adapt your daily activities to cause positive change, and become an effective and responsible citizen through active political participation.

Best wishes for meeting the challenges of 2000.

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The People Connection

Every human society is faced with not one population problem but with two: How to beget and rear enough children and how not to beget and rear too many.

— Margaret Mead, 1949

Introduction

Imagine yourself as a settler in the early 1860s pushing your way across the Great Plains to a new home and a new life. Encouraged by the Homestead Act of 1862 you, your spouse, and your six children have packed your belongings into a covered wagon and set off in search of land you could call your own.

While crossing the desolate expanses of western prairies and mountain ranges, the sight of another human, especially a friendly one, was seldom and welcome. America's **Industrial Revolution** had yet to make its impact felt in the West. You and your spouse were thankful for your six healthy offspring. Disease had claimed two other children before their first birthdays and there was no guarantee that the remaining family members would survive.

Once settled, there would be work for all of you—and then some! There would be fields to clear and plant, clothes to mend, the house to maintain, and livestock to attend. Maybe a few more children around the house would be even more help. Besides, you could grow old secure in the fact that they would take care of the homestead—and you.

While we don't often think about preindustrial America as a **less developed country (LDC),** it was like an LDC in many respects. For example, both the **birth rate** and **death rate** were high, but of course the birth rate was somewhat higher—or we would have become extinct!

Humans have experienced high birth rates and high death rates for most of recorded history. Only since the 1800s have death rates fallen in **developed countries (DC)** due to advancements in public health, communication, transportation, medicine, and nutrition. This was also around the time of the Industrial Revolution and people were moving to the cities to find work. With the improvements in living conditions and new lifestyles, people felt more secure knowing that the children they did have would probably live. Because they no longer needed the extra labor provided by farm children in their city businesses, they began having smaller families. As these changes took place on a large scale, industrialized societies such as those in the U.S. and western Europe experienced lower death *and* lower birth rates. With the exception of the **Baby Boom** period after World War II when families were generally larger, the low birth and death rates continue today in the developed countries. In fact, the population of several countries such as Austria, East and West Germany, and Luxembourg have stopped growing.

Why, then, all the fuss about population growth? As you can see from the following chart, it took humans several million years to reach their first billion people.

Each subsequent billion has been added in shorter and shorter time periods. This is because more people are living and are living longer. Thus any addition to the population is added to an expansively-growing base. Ironically, it has not been an increase in the birth rate which has accounted for our present size. In most countries, birth rates are declining steadily or staying about the same. Instead, we are still growing because the death rates have been reduced worldwide.

ESTIMATED TIME TO REACH EACH BILLION OF WORLD POPULATION

World Population	Years Taken To Reach	Year Attained
1st bil.	2-5 million yrs.	About 1800 AD
2nd bil.	Approx. 130	1930
3rd bil.	30	1960
4th bil.	15	1975
5th bil.	12 Projected	1987
6th bil.	11 Projected	1998

Source: Population Reference Bureau. "Our Population Predicament: A New Look," 1979, Vol. 35, *Population Bulletin*, No. 5, page 4.

In the *Global 2000 Report*, **projections** indicate that by the year 2000, the world's population may be around 6.35 billion—up from our 1981 population of 4.5 billion. Ninety-two percent of this growth will take place in the LDCs. In addition to this unprecedented growth, a mass movement from rural areas into the cities of these LDCs is anticipated as families look for better food, housing, and jobs. This will place added strain on cities which find it difficult to meet the needs of their present occupants.

Since most of the developed world is reaching **stabilization,** why aren't the less developed countries following suit more quickly? If you return to the original settler image, you can see that not only was it necessary to have many children to assure that some would outwit death, but to help on the farm and to provide for the parents' old age security. Many of these same attitudes currently prevail in the LDCs. These countries are still largely agricultural and change there comes slowly. Many governments are encouraging smaller families. However, changing values and traditions takes a long time, especially when universal education, opportunities for women working outside the home, and other modernizing influences are absent.

Our built-in momentum of growth through the year 2000 implies that it may be difficult for us to stay within the limits the Earth can support. There is no doubt policies and events in LDCs affect the developed world, and vice versa. It will take cooperation between the two if we are to meet the challenges posed by our growing numbers.

Activity

Purpose: As you complete the following activity you will contrast growth between the U.S., a developed country, and Nigeria, a less developed country.

Description: The **growth rate** is a term which describes how rapidly a population is increasing or decreasing. It is based on the births, deaths, and **net migration** experienced in a country in a given year. Using the following chart calculate the total population in the year 2000 for both the U.S. and Nigeria, then graph the populations for the U.S. and Nigeria in 1975 and 2000.

As you will see, populations grow **exponentially.** That is, each year's growth is added to the base population of the preceding year before additional calculations are done. For example, to find the 1976 population of Nigeria, multiply the 1975 population by the growth rate of three percent. You will then add the product to the 1975 population to find the 1976 total population. To find the 1977 population, follow the same procedure: multiply the 1976 total population by the growth rate of three percent and add the

product to the 1976 population. Continue in the same manner through 2000 for each country. Assume that the growth rates given in the chart will remain the same through 2000. Although the calculations are lengthy, they are not difficult. A hand calculator will help. When you have finished, fill in the blanks on the chart with your final answers.

Population	U.S.	Nigeria
Total Pop. 1975 (in millions)	214	63
Total Pop. 2000 (in millions)		
Annual Average Growth Rate (%)	0.6	3.0

Now graph your findings. Plot the population of Nigeria in 1975 and 2000. Plot the population of the U.S. in 1975 and 2000. (The vertical axis should represent the number of people in millions and the horizontal axis should represent time in years.) How many people will Nigeria have added between 1975 and 2000? The U.S.? Express the population growth in each country between 1975 and 2000 as a percentage.

Making a Difference

How will *your* city or community fare in 2000 or even 10 years from now? Your teacher will invite your city planner to speak with you about the changes he or she sees for your community in the next 10 years. Discuss ways the planning department is preparing for your city's future. Will there be more youth, people of working age, or senior citizens than there are now? Will the total population size be more or less? How will the expected change in population affect your community's housing, health care, sanitation, energy, water supply, and number of retirement centers and schools? What will be the responsibility of the individual taxpayer (you!)?

As a second step, poll your class to study the ways each of you will become population actors. Your teacher will place the following statements on the board:

1. I do not plan to have any children.
2. I think I might like to have _____ child(ren) when the time is right.
3. I plan to stay in this area for most of my life.
4. I plan to move away from this community.

After you and your classmates have responded to these statements, write a two page paper describing how your plans might affect the areas you remain in, leave, or move to. You might wish to include a discussion of services you think you (or you and your prospective family) might use, your needs for recreation, transportation, and the like.

Learning Aids

AUDIO/VISUAL AIDS

Exploding Cities. Produced and distributed by National Film Board of Canada. May be rented from The University of Michigan Media Resources Center, 416 Fourth Street, Ann Arbor, MI 48109. 16mm film; color/sound, 27 min., 1978.

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World Population. Produced by ZPG Chapter of Carbondale, IL. Distributed by Perspective Films, 369 West Erie St., Chicago, IL 60610. May also be rented from Population Reference Bureau, Washington, DC or National Association for Foreign Student Affairs, Washington, DC. 16mm film; color/sound, 3 min., 1972.

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The Lion's Share

O money, money, money,
I'm not necessarily
one of those who thinks thee holy,
But I often stop to wonder
how thou canst go out so fast
when thou comest in so slowly.

— Ogden Nash

Introduction

Being a modern American is an expensive business. On the average, Americans buy 21,000 gallons of gasoline, 10,150 pounds of meat, 28,000 pounds of milk and cream, and 9000 pounds of wheat in their lifetimes. The cost of raising a child to age 18 is $41,000 to $62,000.*

These figures are averages which were calculated in 1979. Some people might consume considerably more of these commodities while some might consume considerably less. While these figures may reflect what the average American consumes in a lifetime, they don't give any hint about the quality of that life. They also don't indicate how these figures are affected by factors such as family size or total population size. The relationships between income, consumption patterns, productivity, family size, and total population are complex. The interrelationships of these factors have a large impact on our quality of life.

*Source: Population Reference Bureau, 1977 and 1979.

Activity

Purpose: The following activity allows you to examine how family size and income are related to the amount of money each of us spends for food, shelter, transportation, and the many services and products that make our lives more comfortable. By completing it, you will be able to see how these relationships directly affect the way we live.

Description: The activity is divided into three parts. In the first part, you will see how a middle income and low income family in the United States spend their salaries. You will then calculate how much money is available for each family member if family size increases. In the second part, you will work with a chart showing the **gross national product (GNP)** of several countries. From this chart, you will calculate the individual and family "share" of the GNP for each country. In the third part, you will examine one example of how GNP and population size relate to each other.

Part One: Look at the Monthly Budget Chart on the next page and compare how these two families spend their money. Answer the following questions:

a. What item takes the largest percentage of the family income in the low income family? Is it the same for the middle income family?
b. The chart shows figures for one month. How much does a low income family spend on food in a year? For housing?
c. If the family were to grow by two more children (and the income remained the same), what would be

MONTHLY BUDGET CHART* (The family includes a father, mother, son, and daughter.)

	Middle Income		Low Income	
	% Income	Amount	% Income	Amount
Food	24	$342	30	$262
Housing and Utilities	24	$342	20	$175
Transportation	9	$128	8	$ 70
Clothing	7	$100	8	$ 70
Medical	6	$ 85	10	$ 87
Miscellaneous Gifts, Insurance, etc.	6	$ 85	7	$ 61
Taxes and Social Security	20	$285	13	$113
Other	4	$ 58	4	$ 37
	100%	$1425/month	100%	$875/month

the average amount of money available for each family member in a year? How much would each member have for food? (Assume that the money and food are divided equally among all family members even though children may actually consume less than adults.)

Part Two: Review the chart at right.

a. Which country has the highest GNP? The lowest?

b. If the United States had a 1981 population of 228 million, what is each citizen's "share" of the GNP? Does each citizen receive this amount?

c. If China's population is 900 million, what is each Chinese person's "share" of the GNP?

d. Does this mean that each person in the U.S. has 22 times more money to spend for goods and services than someone in China? Don't forget that GNP is not the same as the family income shown in the first chart. It includes many items besides wages paid. However, GNP does tend to indicate the relative availability of goods and services in a particular country.

*Source: *Simplified Home Budget Book*, Dome Publishing Co., Inc., 1979.

GNP OF SELECTED COUNTRIES, 1975

United States	$1,508,680,000,000
People's Republic of China	285,960,000,000
India	91,810,000,000
Saudi Arabia	24,960,000,000
Kenya	2,900,000,000
Zaire	3,740,000,000
USSR	665,910,000,000
France	304,600,000,000
Panama	1,770,000,000
Peru	12,520,000,000
Indonesia	24,180,000,000
Mexico	71,170,000,000

Part Three: Look at the third chart below which contrasts India's GNP and population with the GNP and population of the United States.

INDIA

Year	GNP	Population
1975	$ 91,810,000,000	607,370,000
1985	$130,760,000,000	745,390,000
2000	$197,870,000,000	946,760,000

UNITED STATES

Year	GNP	Population
1975	$1,508,680,000,000	216,630,000
1985	$2,233,215,000,000	231,690,000
2000	$3,530,291,000,000	246,840,000

a. Notice that the GNP is projected to increase for both countries. What percent increase for each country is expected by the year 2000? You should find that both the percentage increase and the actual dollar amount are greater for the U.S.
b. What happens to the **per capita** GNP when the population increases are taken into account? To find out, calculate the per capita GNP by dividing the population into the GNP for both countries. Do this for each of the three years. Notice that the per capita GNP for India increases very little (from $151 to $209) while the per capita GNP in the U.S. is projected to increase from $6964 to $14,302. This is an increase of over 100 percent for the U.S., but it amounts to only a 38 percent increase for India. Even though India's GNP is projected to increase over one hundred billion dollars by the year 2000, the average Indian's share of this will amount to only $112.

In summary, answer the following questions:
a. What is the relationship between family size and relative amounts of money available for family members?
b. Which countries in the world have high GNPs? Name three.
c. Why doesn't a substantial increase in the GNP for a country necessarily mean more money for most individuals living in that country?

Making a Difference

The first chart you analyzed shows how two typical American households spend their money. Imagine that you are setting up your own household and are preparing your budget. Will you be married? Going to college? Sharing an apartment with friends? After you decide on your hypothetical situation, look in the classified ads of your newspaper to see how much monthly rent you would have to pay for your house or apartment. Use the grocery ads to calculate your food bill for a month. Check your own household's present utility bills to estimate the costs you may anticipate. Look at car ads and estimate monthly car payments, insurance, and gasoline, or calculate monthly bus or subway fare. Then add a figure for miscellaneous expenses such as medical bills, clothing, taxes, entertainment, etc. What is your monthly total? As a last step, turn again to the newspaper and look in the employment section. Do any of the jobs for which you might be qualified provide enough money to meet your monthly bills?

As you do the above activity, divide expenditures into either necessities or luxuries. If your income were to be reduced, what items would you forego?

Are they mostly items you listed as luxuries? Do you think people in countries with low GNPs spend the same percentage of their income for luxuries that you do?

Learning Aids

PRINTED AIDS

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Food for the Future

We always had plenty; our children never cried from hunger, neither were our people in want . . . . The rapids of the Rock River furnished us with an abundance of excellent fish, and the land being very fertile, never failed to produce good crops of corn, beans, pumpkins, and squashes . . . . Here our village stood for more than a hundred years, during all of which time we were the undisputed possessor of the Mississippi Valley. Our village was healthy and there was no such place in the country possessing such advantages, nor hunting grounds better than those we had in our possession. If a prophet had come to our village in those days and told us that the things were to take place which have since come to pass, none of our people would have believed him.

—Black Hawk, Chief of the Sauk and Fox

Introduction

As our population size grows and productive land shrinks, our ability to feed ourselves by our usual methods diminishes. That's no news to the 500 million people in the world today who are already **malnourished.**

The world's population size increases with each passing day, but no new acres are added to the Earth's surface. Croplands presently occupy less than 10 percent of the Earth's land area, and not all crops are food crops. With favorable weather and other conditions, we are able to produce more food than ever. But the amount of food per person is shrinking when compared to our surpluses of the early 1970s. How long our food production can outpace the growing population is the question of the century.

To understand what is happening, compare the amount of available cropland to size of the population which is dependent on this land for food.

Year	Hectares of cropland per person
1800	1.4
1900	0.8
1950	0.5
1970	0.3
2000	0.18

In 2000 there will be only .18 **hectare** per person. The same hectare that supported 2.6 people in 1970 will be required to produce enough food for four. (To calculate the number of acres of cropland theoretically available to each person, multiply the number of hectares by 2.5. Each hectare is equivalent to 2.5 acres.)

Distribution problems and rising food costs pull food even farther away from many tables. The *Global 2000 Report* states that the "outlook for improved diets for the poorest people in the poorest countries is sobering. In the 1970s, consumption of calories in **less developed countries** averaged only 94 percent of the minimum requirements set by the U.N. Food and Agriculture Organization (FAO)."

The FAO standard is the bare minimum needed to allow normal activity and good health in adults and enables children to grow and develop normally in the absence of disease. The standard varies for different countries because of geographic and climatic differences. Persons living in warmer climates are generally less active during the warm season and require fewer calories per day. For example, in 1980 the FAO determined 2390 calories were needed per person per day in the South American countries of Brazil and Bolivia, while 2640 calories were needed for a person in the U.S. and 2660 for one living in Canada.

Despite ongoing rifts between population size and the number of people eating adequate diets, the *Global 2000 Report* projects that food production will be 90 percent higher in 2000 than it was in 1970. Much of this increase in production is a result of the **Green Revolution** which occurred from the 1950s to the early 1970s. Plant breeders and agricultural experts were able to produce strains of grain which far exceeded previous yields. Marginal croplands were placed into production through **irrigation** and other new farming techniques. This spurt in agricultural productivity helped. Whether it can be sustained may depend on our ability to maintain soil fertility, to slow the transformation of farmland into cities and deserts, and to curb energy costs. These factors are made worse by continued population growth, and they will limit our ability to produce more food in the future.

Can the world raise enough food at a price people can afford? Will it be at the expense of environmental quality? A challenge? Yes. In the following activity, you are asked to meet that challenge.

Activity

Purpose: This activity will enable you to decide how you would feed a greater number of people on the same amount of land.

Description: Imagine that you are a farmer. You hear about an international competition and you want to enter. The competition calls for teams of four farmers to devise a food production plan. The plan must show how your team would produce enough food to feed 4000 people by the year 2000 from the same acreage that fed 2600 people in 1970. If your plan is adopted, your team will win 2500 acres of prime farmland. (The prize is equivalent to the number of acres required to produce food for 2600 people in 1970 and 4000 in the year 2000.)

Form your own teams of four persons. One team of four (or more) should be designated as the panel of judges. The panel will evaluate your plan on the following points, so you should consider them carefully:

- *Technical feasibility*—Can the job be done as you propose it? Have the methods already been developed, or will you have to develop them?
- *Environmental acceptability*—Will your plan be harmful to the land and thus decrease its capacity to produce food in the long run? How will your plan affect the environment?
- *Cost effectiveness*—Are your methods efficient enough that once food is produced, people can afford it?

Below are some ideas you might want to consider when devising your plan. Each can help to increase food production (or in the short run help to prevent a decrease). However, several are "catch 22 s"—they may work, but they cause "side effects." For example, if your team proposes irrigation, you should be aware that irrigation builds up **toxic salts** in soils. If you use the wrong **pesticides** and **herbicides,** you can contaminate food chains and kill wildlife—including insects beneficial to farming. What trade-offs do you think you can afford? Because you will need to address the pros and cons of the options you choose, research will be necessary.

Methods for Increasing Food Production

- Improve food preservation techniques.
- Bring land into production that is now devoted to nonfood crops; for example, land used for growing tobacco or other nonfood commodities.
- Irrigate deserts and marginal lands.
- Carry out land reforms; curb conversion of valuable farmland to urban development.
- Develop new strains of crops and other foods.
- Use more pesticides.
- Use more fertilizers.
- Grow more grain crops and raise less

livestock because livestock requires more energy in grain than it gives in meat.
- Shift the balance of livestock raised; for example, raise more goats and fewer cattle. Goats are a better food-raising value.
- Begin intensively farming the oceans; grow plankton, for example.

Each competing team must devise a plan with justifications of the method or combination of methods used. Everyone on the teams and on the judges' panel must be familiar with the world food issue in order to present a feasible plan or to evaluate the plans submitted.

Researching and writing the plans should be completed in two weeks' time. Summaries of all written plans should be presented orally by a spokesperson for each team in the competition. Members of all teams and the panel of judges should be present during the presentations and discussions. The judges should then spend a few days reviewing the plans before deciding on a winner.

Making a Difference

Monitor your own food consumption for one week. Keep a list of the foods you consume and the approximate amounts. Classify them into the four major food groups: meat and proteins, milk and dairy products, breads and cereals, and fruits and vegetables.

Record the number of calories found in the foods you have eaten. You should be able to find calorie charts in your home economics department, in books about diet and nutrition, or in many cookbooks. Compare your caloric intake with that of individuals who live in less developed countries. If you are an "average American," you probably consume over 3000 calories per day. An "average" individual in a poor country probably consumes only 2100 calories per day.

Plan and adopt a diet that considers:
- *High nutritional value*—Look at the major food groups and daily requirements again. Is your diet balanced?
- *Cost to produce and process*—Do you eat many processed foods? What are the alternatives to the companies and people who process the food?
- *Rank on the food chain*—Vegetables are lower on the food chain than meats. They are digested more easily. They are less costly to produce and yield more food for the money.
- *Acceptability to taste*—The foods we eat are largely a product of our culture. Do you reject nutritional foods just because you are unfamiliar with them?

After you have completed these activities, gather again in your four person teams. Try to reach a consensus on each of the following statements.* Your teacher will be the moderator:

1. Provided we have the technological capacity, it is the moral obligation of our nation to feed all the hungry people of the world.
2. If we provide food to other countries, we have the right to demand that they conform to certain policies, such as controlling population growth.
3. We should reduce our meat consumption so that more people will be able to eat the grain that would have been used to feed cattle.

Were you able to reach a decision with which everyone in your group was happy?

*Adapted from "Population Opinions," an exercise developed by Dorothy Cox.

Learning Aids

AUDIO/VISUAL AIDS

And Who Shall Feed This World? Produced by National Broadcasting Company. Distributed by Films, Inc., 733 Green Bay Road, Wilmette, IL 60091. 16mm film; color/sound, 47 min., 1975.

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4

Ode to a Fish

I must down to the sea again,
to the lonely sea and the sky,
And all I ask is a tall ship
and a star to steer her by . . . .
I must down to the sea again,
to the vagrant gypsy life,
To the gull's way and the whale's way
where the wind's like a whetted,
knife.

—John Masefield, "Sea Fever," 1902

Introduction

The value of the world's oceans is difficult to calculate. Some benefits we receive from the ocean such as the annual catch of salmon can be assigned a dollar figure. Other benefits such as the crashing of waves and the smell of salt at a beautiful beach don't easily fit into any economic system.

One fact is beyond dispute, however: the fish and other marine animals that the oceans supply are an extremely important source of protein. It is estimated that the average person needs about 36 grams of protein each day to grow and develop normally. In 1975 the ocean yielded 60 million metric tons of fish, whales, shrimps, and other marine animals. This roughly equals 12 million metric tons of protein, or about 30 percent of the world's protein needs.

At one time it was assumed the oceans had an unlimited ability to produce fish. It was thought that improving fishing techniques (the use of electronic gear to locate schools of fish, bigger and specially designed nets, etc.) would increase annual catches dramatically. This has not happened. The world marine fish catch peaked in 1970 at just under 53 million metric tons. Since then the trend of fish harvest has been slightly downward.

The decline in marine fish catch has been partially offset by increased catches of freshwater fish. However, even if production of all fish were to increase to 100 million metric tons by the year 2000, the growing world population would mean that the seas could produce no more than one-quarter of the world's needed protein. This compares with the 30 percent of protein supplied in 1975. Since a level of 60 million tons is a more realistic level to expect in 2000, the **per capita** production of fish protein will probably be lower than 25 percent.

Actually, the preceding figures are misleading and optimistic, since all fish protein is not used for human food. Some is used indirectly in food production. Anchovies, for instance, are ground into **fish meal,** which is then used as fertilizer or in concentrated animal feed. (The last chicken you ate may have been raised on sardines caught off the coast of South America!) Marine animals are a major component of many pet foods. Fish by-products and whale meat are ingredients in many dog and cat foods. **Fish oil** is also produced in large quantities and used in some livestock feeds and grocery products. Slightly over one-third of fish protein is used for fish meal and fish oil production.

Activity

Purpose: The Introduction focuses on oceans as an important source of protein. Oceans provide a great many other products, some of which are more apparent than others. For instance, most of us are aware that shells and shark teeth are used in jewelry, but did you know that crushed coral is used as a building material? One way to gain deeper insight into the value of oceans is to analyze how people use and regard marine products. By doing this we can reach a better understanding of how important the marine environment is.

The following activity takes you back through time so you can examine how famous people regarded oceans. A second part of the activity looks at the uses (both usual and unusual) we have found for marine products.

Description: Mythology, the *Odyssey* of Homer, and the Old and New Testament of the *Bible* all contain interesting references to the sea and sea products. It's easy to see that the marine environment has been considered important by many different cultures throughout the ages. Your goal in the first part of the activity will be to find as many references to the sea, its inhabitants, and its products as possible in your school library, and to group them into similar classifications of use. The following classifications are suggested, but you may want to add more:

1. Uses for Marine Products

a. Food
b. Ornaments and clothing
c. Fertilizers
d. Money
e. Oil
f. Building materials

As you find a reference to a marine product, list it under one of the classifications you have established.

2. References

A good place to start compiling your list is the subject index of the library's card catalog. Think of as many marine-related subjects as you can—ships, clams, fish, saltwater, coral, whales, **scrimshaw,** trawlers and other fishing boats, nets, etc. Look them up in the card catalog to find books that deal with those subjects. The encyclopedia can suggest other marine topics.

This method will identify many sources in nonfiction books. However, it will leave the whole area of fiction largely untouched. One way to tap this vast area is to go to compilations such as *Bullfinch's Mythology or Bartlett's Familiar Quotations.* Bartlett's, for instance, could lead you to over 15 different books, poems, plays, or stories that mention whales. You may remember books you have read or movies you have seen that suggested additional sources. *Treasure Island, The Tempest, Moby Dick,* and *Cannery Row* are but a few famous works of fiction in which the sea figures prominently.

As you conduct your survey in the library, write each title under the appropriate use category. Do you find that you have to redefine your categories as you find new uses? Are there some references that didn't seem to fit anywhere? (Where would you put *Jaws* or the giant squid in James Bond's *Thunderball*?)

3. Analysis

Discuss your list with other students. Who had the longest list? Whose list was the most diverse and included the most uses? If you are like many researchers in this area, you will find that fish and fish products are most commonly referred to as sources of food. Why do you think this is true?

4. Uses of Fish Protein

Unless you ran across the story of how Squanto helped the Pilgrims survive by using fish to fertilize their corn, you probably didn't uncover this important use of fish protein. However, as the Introduction indicates, about one-third of the fish catch is used for fish meal and fish oil. What other less commonplace uses of marine resources can you find? Continue this second analysis in your grocery store. Read the labels of items such as pet foods, shampoos, lawn fertilizers,

medicines, and other common products. You may have to do a bit of detective work since chemical names are often used on labels. For instance, glycol alginate and carrageen are both developed from seaweed to make salad dressings and ice cream smoother. More obvious examples are items such as crushed seashells and coral used for decorations in flower beds. Other additions to your marine shopping list might include sponges, pearls, or cod liver oil.

Making a Difference

Considerable controversy exists about how fish should be used. At one time it was thought that the oceans would yield an inexhaustible supply of fish forever. As the Introduction demonstrates, this isn't true. A close look at priorities for use of fish protein becomes important when the limited nature of the resource is known. How do you feel about the fact that some nations still kill whales for pet food? Should Eskimos kill whales for oil and food as they have done for centuries? Should the fish from the oceans off the coast of Peru be used to fertilize corn in Mexico? Should countries be allowed to claim fishing rights 200 miles off their coasts in order to insure their "fair share" of fish? You may have some thoughts about the way marine resources might best be used.

As one way to investigate these interesting questions further, you can organize a debate. Find another student in the class who is also doing this activity. Each of you can research opposite sides of an issue such as the use of fish protein for pet food. Ask several other students to act as judges and debate the issue in front of the class. Have the judges decide the winner or poll the class to see which side of the argument has the most support. In a similar way, you could join with a few classmates to prepare a short play depicting one of the issues. Presenting the play to the rest of the class might cause other students to consider how they feel about topics such as the killing of whales by Eskimos.

A second way to make a difference is to make sure that people are better informed about the issues. You could investigate a problem such as the accidental killing of dolphins in commercial tuna fishing operations and write an article for the school or community newspaper based on your findings. You can also lead a consumer hike through your grocery store to call attention to the different uses of fish protein.

One thing to remember: as with most resource concerns, there is no easy answer, no absolute right or wrong. There is just the tough question of how to divide a limited resource among an ever-growing population.

Learning Aids

PRINTED AIDS

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5

"BTUs" = Better Timber Uses

A sage, in rambling about the Heights of Shang, saw a large and extraordinary tree. The teams of a thousand chariots might be sheltered under it, and its shade would cover them all! He said, "What a tree this is! It must contain an extraordinary amount of timber!"

When he looked up, however, at its smaller branches, they were so twisted and crooked that they could not be made into rafters and beams; when he looked down to its root, its stem was divided into so many rounded portions that neither coffin nor shell could be made from them. He licked one of its leaves, and his mouth felt torn and wounded. The smell of it would make a man frantic, as if intoxicated, for more than three whole days together.

"This, indeed," said he, "is a tree good for nothing, and it is thus that it has reached so great an age." . . . The cinnamon tree can be eaten, and therefore it is cut down. The varnish tree is useful, and therefore incisions are made in it. All men know the advantage of being useful, but no one knows the advantage of being useless.

— Chuang Tzu

Introduction

Forests are being destroyed at rapid rates because more and more people are using more wood and wood products in their homes and at work.

In the early 1970s, virgin, or never before cut forests, covered over one-third of the world's land surface. Only a tiny fraction—one percent—was actually being used. Now, as then, most virgin forest is located in tropical areas. Today the largest tracts of forests are found in **less developed countries (LDCs).**

Tropical forests contain the most diversity of plants and animals of any land **habitat.** One acre of tropical rain forest may support over 100 different kinds of trees and a vast array of animals. The animals live at every level of the forest, from the ground floor to the treetops or canopy. Forests tend to stabilize water supplies and flows thus preventing floods, soil **erosion,** and water pollution. They also produce a significant amount of oxygen and influence climate and temperature.

By the year 2020, the *Global 2000 Report* projects that virtually all accessible forests in less developed countries will have been harvested. The main use of wood in the LDCs is and will be fuel for cooking and heating. Each villager living in a less developed country uses about one ton of fuel wood per year. A report released from China provides a vivid example of this rapid loss of forest. In Wusheng County, located in the heavily populated Sichuan Province of 100 million people, the forest covered nearly 10,000 **hectares** in the early 1950s. In 1981, only 55.5 hectares of forest were standing.

Uses of wood from forests in the **developed countries (DCs)** differ greatly from those in the less developed countries. Major uses in developed countries include lumber, wood panels, and paper. Regardless of use, price—increasing price—will affect people in developed countries and less developed countries as supplies of wood dwindle.

To increase the supply of wood and at the same time stabilize water supplies and prevent soil erosion, **reforestation** is the only answer. Unlike some other natural resources, wood is a renewable resource. Today, some replanting is

occurring but not enough to keep up with current forest losses.

Further encouragement and positive results may come from forest research and from an increasing global awareness of the importance of large forest areas. "Super trees," those with very rapid growth rates, may help combat forest destruction. Part of the necessary awareness and understanding of the forest issue may come from completing the following activity.

Activity

Purpose: Learn more about the forest industry and about demands for and use of forest products.

Description: To gain a more complete understanding of the importance of forests and their by-products, complete all of Part One. Then complete Part Two, Three, or Four and submit a three page paper on your findings to your teacher. Library references, state forestry departments, the U.S. Forest Service, or your county extension agent may help to supply information.

Part One: Listed above are five different kinds of firewood and the heat value (output) from burning one cord of each. A cord is a measure for wood equalling a pile 4x4x8 feet or 128 cubic feet.

Tree species	Weight per cord (pounds)	*BTUs per cord (millions)
Hickory	4200	27
Red Oak	3700	24
Aspen	2300	15
Spruce	2400	16
White Pine	2100	14

*Heat values (outputs) are expressed in **British Thermal Units.** A BTU is the amount of energy necessary to heat one pound of water one degree Fahrenheit. Most heat values are expressed in BTUs.

a. Calculate the number of BTUs in each pound of the different woods listed. Which has the highest? The lowest? Are any the same?
b. Are the woods with the highest numbers of BTUs per pound the best firewoods?
c. Choose one of the alternative fuels listed below. Find how much of that fuel would be required to provide the same heat as one cord of hickory and one cord of white pine. For each, you must first determine the number of BTUs per unit measure.

- *Animal Dung:* In some less developed countries, **dung** or manure is second only to firewood as the main source of domestic fuel. Dung is gathered from plant-eating animals such as cattle, bison, buffalo, camels, and horses. Give your answer in pounds as the unit measure.
- *Kerosene:* This is a **fossil fuel** used in some less developed countries. Oil, coal, and natural gas are not commonly used in less developed countries because of supply and distribution problems and very high cost. Give your answer in gallons as the unit measure.
- *Natural gas:* Natural gas is a fossil fuel used in large quantities by several developed countries. Give your answer in cubic feet as the unit measure.

Part Two: Compare the forest industry of a specific developed country with that of a specific less developed country. You may wish to consider what forest products are manufactured, if any; in what quantity; whether they are used within that country or exported; and whether the raw material is home-grown or imported. If imports and exports are part of the investigation, indicate what commodities countries are trading with the countries you have chosen.

Part Three: Investigate ways persons who live in less developed countries might use resources other than firewood to cook their food and heat their homes. Two examples are making alcohol from **crop wastes** or producing gas from human, farm, animal, and plant wastes.

Part Four: Compare the major demands for wood in developed countries and less developed countries of the world.

Making a Difference

Two ways that you personally can help make a difference are to consume less and waste less. Make a list of what you would consider to be nonessential uses of wood. Work alone at first. Then, together with classmates, make a master list of the different nonessential uses you have identified. You might wish to call this a list of "timber taboos." Add to the list of timber taboos ways you might conserve forest products. Using less paper and paper products, and recycling paper and wood are examples that you could list. Type the list and circulate it through a community nature center, garden club, or other group which would have an interest in this topic.

Start a paper recycling center. Many of the guidelines provided in the "For Never More" unit for starting and operating a metals recycling center can be applied as you start your paper recycling center.

The National Association of State Foresters can provide a list of forestry departments in each state, and the U.S. Forest Service can provide information about trees and lumbering practices.

National Association of State Foresters
President: Donald McFatter
Office of Forestry
Department of Natural Resources
PO Box 1628
Baton Rouge, LA 70821

U.S. Forest Service
Department of Agriculture
PO Box 2417
Washington, DC 20013

Learning Aids

PRINTED AIDS

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See listings at end of "Photo Forest" unit for others.

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6

Roll on Mighty River

I tell you, gentlemen, you are piling up a heritage of conflict and litigation, for there is not sufficient water to supply the land.

—John Wesley Powell, famous explorer of the Colorado River at a conference held in 1893

Introduction

As Ben Franklin observed in 1746, we seldom know how important water is until there is a shortage. Increasingly, however, the importance of water is being brought home by occurrences such as drought, low river flow, and water rationing. In many communities, talk about the weather is more than idle chatter as citizens anxiously watch the clouds for rain which would fill their reservoirs or save the crops. This problem is particularly acute in many western states. The Ogallala Aquifer, a natural underground reservoir beneath parts of Oklahoma, Colorado, Texas, New Mexico, Nebraska, and Kansas, supplies millions of gallons of needed water every year. However, expanding industry, influx of people into the area, and intensive use of **irrigation** are creating demands which threaten to suck the Ogallala dry. In a like manner, underground lakes in Arizona are being pumped dry to provide water for Arizona's growing cities and farms.

Competition for water is severe with states, individuals, companies, national governments, and Indian tribes all vying for their "fair" share. In the case of the Colorado River, the claims for water from the river actually add up to more water than flows in the river!

Increased population in urban areas and increased use of irrigation are two of the main reasons that demand for water has grown significantly in recent years. As more and more water is withdrawn from rivers, they lose the ability to support aquatic life. As streams become shallower and slower, they warm and lose their ability to retain oxygen. Fish and aquatic insects die from the heat and lack of oxygen. This in turn affects animals such as eagles, otters, and raccoons which feed on these smaller aquatic organisms. In extreme cases, the river may actually dry up for short periods, often with disastrous effects for wildlife. A fish needs water 365 days a year; 364 won't do.

Irrigation can cause problems in addition to low river flows. Irrigation results in the loss of an estimated 125,000 **hectares** of farmland each year due to impaired drainage or buildup of **toxic salts** in the soil. Problems such as these occur where irrigation systems supply water to the soil faster than drainage can remove it. Evaporation brings dissolved soil salts to the surface where they may interfere with plant growth. The water that returns to local streams and rivers is often so laden with salts that aquatic plants and animals are killed. While the technology exists for removing the excess salt from polluted waters, **desalinization** is a costly and **energy-intensive** solution.

Activity

Purpose: By participating in the following activity, you will be able to get a firsthand sense of the complexity and frustration surrounding water use problems in our western states. By examining these issues, you can also see how similar circumstances might affect your own community.

Description: Many of the problems associated with water quality and shortages can be seen clearly and dramatically by investigating water use along the Colorado River. As the following summary shows, there is often not enough water to meet demands, and water quality is poor.

Colorado River Use

- *Average Flow:* 13.5 million **acre feet**
- *Claims on water before it reaches Mexico:* 15 million acre feet
- *Total dissolved solids in lower river:* 850 milligrams/liter
- *Maximum dissolved solids for plant growth:* 500 milligrams/liter
- *Flow patterns:* high flow in spring, low flow in late summer with dry stretches in drought years
- *Water quality other than dissolved solids:* some problems with industrial waste and sewage, particularly from Yuma and Las Vegas
- *Main uses:* large amounts withdrawn for irrigation. The Colorado is also a major source of water for Los Angeles, San Diego, Bakersfield, Las Vegas, and many smaller cities.

A variety of groups compete for water from the Colorado. You are a judge who has been assigned to arbitrate conflicting demands between these groups. The various **plaintiffs** are listed below. You should ask other students to play the role of each of the three plaintiffs.

1. *Sugar beet farmer in Colorado.* You need water for irrigation to grow your sugar beets. Producing sugar in Colorado is an important farm industry and supports many jobs. Without water for irrigation your farm would be worthless and you would have to move to the city to find work.
2. *City planner.* You need water for the growing number of homes and industries in your city. Without the water, your city will not be able to expand and the local economy will suffer. The city needs clean, unpolluted water for drinking and manufacturing.
3. *Representative of the Mexican Government.* The water that flows out of the United States into the Gulf of California is so polluted with salts that it is virtually unusable. You want the U.S. Government to construct a desalinization plant so that water entering Mexico will be pure enough for drinking and irrigation.

Give the plaintiffs time to research their positions in the library. This should take several days. Advise them of the points they should cover and encourage them to use charts and posters to summarize their positions. You will also need to spend time in the library in order to prepare for the trial. When everyone is ready, hold the trial with the whole class watching as the three plaintiffs present their cases. As the presentations are made, you should ask questions based on your research.

After the presentations, you will need to make a decision and design a plan of action. The plan can be discussed in a three page paper or a 10 minute oral presentation to the plaintiffs and other class members. In the plan, you may decide in favor of a specific course of action such as giving the city more water and the farmers less. You could require the plaintiffs to conserve water. Or you could recommend technological solutions such as desalinization. Your final plan should set priorities for water use in the area, explain why you set those priorities, and indicate how conflicting demands might be met in the future. Before you complete your plan, you may want to play the WATER RESOURCES GAME in the "Go with the Flow" unit to learn more facts about water use.

Making a Difference

As you probably discovered in this activity, short of impractical or extremely expensive efforts like weather modification or construction of desalinization plants, it is almost impossible to "create" more water. The only way to make more water available is to save it.

There are many ways to save water in your everyday life. You can wash the car from a bucket rather than letting a hose run; you can take short showers rather than tub baths; you can turn the water off when you brush your teeth; you can collect rain water to water house plants; you can place **flow restricters** in showerheads and bricks in toilet tanks to reduce water use. (Certain bricks may crumble and clog sewage systems. A plastic container filled with stones or water to weight it may be better.)

One systematic way to save water is to conduct a water audit of your school or home. Record all the ways water is used and design a water conservation plan to reduce use. Persuade school officials and your family to carry out the plan and monitor water use by comparing present and future water meter readings.

Learning Aids

AUDIO/VISUAL AIDS

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PRINTED AIDS

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7

For Never More

Man thinks of himself as a creator instead of a user and this delusion is robbing him, not only of his natural heritage, but perhaps of his future.

— Helen Hoover

Introduction

It is easy to see that countries which have historically consumed the most natural gas, oil, and coal are also the **developed countries (DCs)** of this world. Contrasted with **less developed countries (LDCs),** many people would conclude that the developed countries have consumed more than their share of **fuel minerals.** It can be argued that the industrialized countries have consumed **nonfuel minerals** such as iron and tin in the same manner.

Aside from removing precious metals and rare gems from the Earth's crust, mining nonfuel minerals is relatively new. Only in the past century have we begun to mine and consume nonfuel minerals in any quantity. Today, we consume these minerals faster than the rate of population increase. Yet the fact remains: the supply of nonfuel minerals has definite limits and can be exhausted.

What are examples of nonfuel minerals? They include silver, zinc, mercury, sulfur, lead, tungsten, tin, copper, nickel, platinum, phosphate, manganese, iron, aluminum, chromium, and potash. All these minerals are used in industry. Depending on the developments and shifts in technology, many are in great demand.

Most countries import or export raw nonfuel minerals; some are both importers and exporters. The United States is one of the most mineral-rich nations in the world and is also one of the world's leading importers. Sources indicate that if the world's 3.7 billion people in 1970 had been enjoying the average American's standard of living, 75 times more iron and zinc would have been needed, 100 times more copper, 200 times as much lead, and 250 times as much tin!

Many LDCs have plentiful nonfuel mineral deposits but have neither the money nor technology to mine the raw material. These countries often allow prosperous foreign corporations to mine their raw materials in order to bring money into the countries' economies. However, in many cases, little of the profit makes its way back to the local marketplace. In addition, mining practices which extract the minerals as quickly and cheaply as possible may cause long-term environmental damage.

In addition to their fluctuating economies, the political systems in many LDCs are also unstable. These circumstances increase the possibility for internal and external conflict.

The *Global 2000 Report* did not cite a present scarcity of most nonfuel minerals. The mining of these minerals has increased to meet demand. This trend is expected to continue into the year 2000 if living conditions remain about the same. However, as the most easily reached minerals are used, mining costs will rise. Prices will increase for any product

MINERAL USE CHART

Nonfuel Mineral	Major Uses	Primary Source	Dependent Country

containing those minerals. Higher prices could severely limit the availability of these minerals and products made from them, especially in less developed countries.

We can only take from this mineral supply; we cannot replenish or restore it. Given the limited supply of nonfuel minerals and escalating mining costs, recycling nonfuel mineral products and substituting other materials for nonfuel minerals must play a bigger role in our lives.

Activity

Purpose: By completing the chart, you will discover how important nonfuel minerals are to us in our daily lives.

Description: Select ten nonfuel minerals mentioned in the Introduction.

- List these minerals in the first column of the chart.
- In the second column, list two major uses of each mineral. You should be able to obtain this information easily by using the library.
- In the third column, identify a country or geographic region which is a primary source of the mineral.
- The fourth column requires that you name a country which is highly dependent on the mineral. The country where the mineral is found and the country using a large quantity of the mineral may be the same.

Once you have completed the chart, obtain a large wall map of the world. You will need only one for the entire class. On the map, pinpoint the countries you have identified as major sources and major users of each nonfuel mineral you chose. With a piece of colored yarn, connect the two countries involved in each nonfuel mineral relationship. Your map should have ten pieces of yarn which will help you and other students see geographic relationships.

Next, summarize on a 3" x 5" card, the following information:

- Population sizes of the connected countries
- The political system under which each country is governed and the general socio-economic conditions in each country
- Possible problems that a mineral shortage (resulting from political instability, exhausted mineral supply, etc.) could cause

Pin the card to the yarn in order to explain the nonfuel mineral "connections" to anyone looking at your display. Could a nonfuel mineral problem between connected countries cause problems for other countries that are not part of the specific link you have shown?

Optional Activity

The following is an optional game in which you may experience firsthand the "negotiations" involved in nonfuel mineral "trading."

Prepare the materials needed: a set of poker chips or similar tokens in three colors, so that one chip of each color is available for half the members in the class. Count the chips to be sure equal amounts of all three colors are available. Select an indoor area large enough to allow free movement.

Divide the group in half. Group One will participate in the first game. Group Two will observe. The object of the game is to obtain chips of all three colors. Each color represents a portion of a certain nonfuel mineral. You are free to choose whatever nonfuel minerals you wish. Blue chips, for instance, may represent phosphates, red chips may represent copper, and white chips, iron ore.

Tell Group One that they comprise a population of a country and that each member needs a supply of these three resources. Explain that the total number of chips represents the entire world supply of each of these nonfuel minerals.

After showing the chips or tokens to the group, throw them randomly into the space where free movement is allowed. On a signal, members of Group One should try to get one chip of each resource. (Collecting is limited to three chips per person.) The game is complete when each student gets all three nonfuel mineral resource chips. Collect the chips from the students.

Invite Group Two to join Group One so that the entire class is now involved. Tell the class that the combined groups now represent the populations of all countries in the world.

Again, randomly distribute chips. This time each member of the entire group must attempt to collect at least one of each resource chip. However, there is no limit to the number that each person (country) may collect. The game is finished when all chips have been collected.

Analyze the two games. Determine who is resource-rich and resource-poor. Determine whether each group member got at least one chip each time the game was played. Devise ways each player could collect at least one chip. What do these actions mean in real world politics and economics? Regulations and laws? Sales and trade? Remember, more chips cannot be created just as the total world supply of nonfuel minerals cannot be increased.

Making a Difference

You or your group may wish to start a nonfuel mineral recycling project or center. Discuss the benefits of such a project and determine which nonfuel mineral

items would be feasible to collect. You may choose to collect one or several nonfuel mineral products. Metals, particularly aluminum, are popular.

If you decide to start a recycling center, here are some things to consider:

- What is your objective in operating a recycling center—conservation of natural resources? Making money? Both?
- Is there a market for your recycled materials?
- How much recyclable material do you plan to collect?
- Where will the collection point be located?
- How will it be staffed? Will it be secure when not staffed?
- What objections, if any, do you expect from neighbors or others?
- What roles will the school principal, maintenance and kitchen staff, teachers, and other students play?
- How will you transport your goods to the main recycling point?
- How will you publicize and enlist support for your center? School and community newspapers and posters are worth considering.

You may want to start your center on a completely voluntary basis. Eventually, if you are paid for the recyclables you turn in to the main recycling depot, you may want to return part of your profit to those who donate to your center. This would be a real incentive for people to save and forward collectables to your center.

Learning Aids

PRINTED AIDS

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Where Do You Get All Your Energy?

The sun, the moon, and the stars would have disappeared long ago had they happened to be within reach of predatory human hands.

— Havelock Ellis

Introduction

Our daily lifestyle is a complex mixture of habit, culture, tradition, and opportunity. We tend to take for granted that the way we live and the things we do are a typical way of life. It's not hard to see that this isn't always so. When we travel, watch TV, or read, we are often introduced to groups or cultures that do things a bit differently than we do.

Lifestyles are linked with our standard of living and thus with our consumption of products and our use of energy. The relatively inexpensive energy available to us in the United States is an important influence on the mobile, fast-moving, and affluent lifestyle many Americans enjoy today. In contrast, the scarcity and cost of energy in many of the world's **less developed countries (LDCs)** force people into a more restrictive lifestyle. For instance, in the desert areas of Africa gathering wood for cooking has now become a full-time effort for one member of the family.

In 1975 the average person from the United States used 332 million **British Thermal Units (BTUs)** of energy. A person from an LDC such as Indonesia probably used about 11 million BTUs in that same year. The world average in 1975 was about 60 million BTUs per person. As you can see, our energy use is over 30 times the amount used by the world's poor.

By the year 1990, the U.S. **per capita** energy consumption is expected to be about 422 million BTUs, while in the LDCs, per capita energy consumption will have risen to only 14 million BTUs. The percentage increases for the United States and LDCs are the same—27 percent. However, the actual amount of energy used by a person in the U.S. versus one in an LDC is vastly different.

How is energy obtained? In 1975 almost half of the world's energy was supplied by oil, about 30 percent from coal, almost 20 percent from natural gas, and less than 10 percent from nuclear and hydro sources. Although the percentages are projected to change over the next 20 years, relative importance of energy sources will probably not vary markedly.

Important as these sources of energy are, they provide an incomplete picture of world energy use. In the LDCs, wood, **crop waste,** charcoal, and **animal dung** are collected and burned daily by an estimated 1.5 billion persons. This represents about 25 percent of the total human population. Firewood has been called the poor person's oil. Its use for fuel is expected to increase by two percent per year. This would lead to a substantial shortage of firewood in many areas before the year 2000. Use of crop wastes and dung for fuel will also increase substantially. In 1970 India generated roughly one-third of its noncom-

mercial energy by burning 68 million tons of cow dung and 39 million tons of crop waste.

Just as energy use patterns differ in various parts of the world, so do the problems caused by energy production and use. Air pollution and **acid rain** are mainly problems of the **developed countries (DCs)** like the United States.

In contrast, LDCs have energy-related problems in other areas. In general, they have less air pollution even though a smoky haze from cooking fires may hang over many cities. However, the collecting of firewood often has disastrous effects on the local environment. Near cities where demand for firewood is high, surrounding areas have already become barren for distances of 50 to 100 kilometers in some places. Satellite photographs of southwest India show a white spot around most every city and village. The white indicates a lack of vegetation; all the trees and shrubs have been collected for firewood. Use of dung and crop waste for fuel also has important environmental effects. When these residues are not returned to the soil, the soil becomes less capable of producing necessary crops.

Activity

Purpose: By completing the following analysis, you can compare the amount of energy used in developed versus less developed countries. This difference in energy use becomes quite apparent when the lifestyles of people in two such countries are contrasted.

Description: Read the descriptions of a typical day in the life of a teenager in America and one in India. As you read, list all the apparent uses of energy—in other words, whenever someone performs work. Remember that human energy is also used to do a lot of work. There are over 10 work-related examples in each description.

1. Kim Edwards is a senior at East High School in Omaha, Nebraska. Her day begins at 7:00 a.m. when her alarm goes off and she begins to get ready for school. Kim showers while her mother fries her bacon and eggs. After gulping down breakfast, she heads for the corner to catch the bus. After a busy day at school which includes watching a film on ecology in the biology class and taping her Spanish lesson, Kim catches the bus back home. She has an afternoon paper route which enables her to save money for college. The truck drops the papers off at the corner and Kim begins her deliveries. After she is finished, she stops at the local store to buy some groceries for her mother. Since it's homecoming Friday, Kim borrows the family car and picks up her friends on the way to the football game. After the game, they stop for a pizza. Kim gets in at midnight.

2. Ramar Singh is in his last year of the Second Standard at a school in Bangalore, India. At 6:00 a.m. Ramar's mother awakens him. He and two of his younger brothers walk to the market to buy firewood, fresh fruit, and milk for breakfast. Since they have no refrigerator, a trip to the market is necessary each day for milk and other perishables. When they return, Ramar's mother starts the fire and prepares masala dosa to go with the fresh fruit. By 8:00 a.m. Ramar gets on his bicycle and heads for school. School seems to go very slowly since Ramar is on the school soccer team and there is a big match that night. Finally classes are finished and Ramar hurries home. Before the match, however, he must work in a local silk factory where he spends several hours each day helping to keep the silk looms running. Finally his work is completed and he heads for his match. His older brother drives a three-wheeled motor taxi for his living and has offered to take Ramar across town for the match. The playing field is not lighted so the match is completed by 8:00 p.m. Ramar and his brother stop at an outdoor stand for tea with some friends. Ramar is home by 10:30 p.m. Since the electricity has been shut off for the night and his father wants to save candles and kerosene, most of the family is already in bed.

How many different uses of energy could you find? Compare and contrast

the ways jobs were done in the U.S. versus India. For example, how did the two people go to the store? What kinds of transportation were used to get to school?

It's easy to see that the teenager in the U.S. used much more energy in her typical day. Most of this energy was not "people" energy; it was derived from oil or coal. Where did the oil and coal come from? What do you think happens when large areas of land are **strip-mined** for coal? When forests are cut for firewood?

If you had a choice, would you prefer to live the life of the typical American or the Indian? If the Indians were given the same choice, how do you think they would respond?

Making a Difference

Most of us would not want to give up our comfortable lifestyle and trade it for the "simpler" lifestyle in less developed countries. Yet, it seems unfair that the U.S. uses so much of the world's energy. We can take measures to save energy—some which require more changes in the way we live than others. See if you can make a difference in your community's energy use by doing several of the following activities:

1. Collect all the glass, newspapers, and aluminum cans at your house for a month and recycle them.

2. Record the times *you* use energy in a typical day and try to substitute less **energy-intensive** activities. For instance, maybe you could ride a bike to the store instead of using your car. Go on an energy "diet" for one week and see how little energy you could use.

3. Conduct an energy audit of your school or home. List specific ways energy and resources are being wasted. Are lights left on in empty rooms? Is paper discarded or recycled? Are doors and windows closed tight or can you see gaps and feel drafts? Is the hot water scalding hot or just hot enough to get the job done? Is the hot water tank insulated? At what temperature is the thermostat set? After you have the results of your audit, you can work with your school or family to develop and implement an energy conservation plan.

Learning Aids

AUDIO/VISUAL AIDS

Sun, Wind, Wood. Produced by National Film Board of Canada. Distributed by Benchmark Films, Inc., P.O. Box 315, Franklin Lakes, NJ 07417. 16mm film; color/sound, 25 min., 1980.

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PRINTED AIDS

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Agriculture: Is Any Culture Left?

Whoever could make ears of corn . . . grow upon a spot where only one grew before, would deserve better of mankind . . . than the whole race of politicians put together.

—Jonathan Swift

Introduction

One definition of "culture" is tillage or cultivation. This is further described as preparing for or aiding the growth of crops. Feeding, clothing, and to some degree housing the people of the world is in large part the function of agriculture. Agriculture provides much of the food and fiber necessary to meet basic human needs.

Agriculture depends on two systems, an environmental system and a social system. Both of these systems must work together to allow agriculture to function smoothly. The environmental system and the social system combine to produce agricultural products, mainly crops. So crops might be considered social-environmental resources.

Both environmental and social systems have their own individual resources. In the environmental system, they include land and soil, water and energy. Land is the area on which crops are grown. Soil is the resource that provides the growing medium for plants and contains the nutrients necessary for plant growth. With proper maintenance it replenishes itself at constant, though lengthy, intervals. Water, of course, is an indispensable agricultural resource. Great lengths have been taken through **irrigation** and other means to assure water supplies in drier areas. Energy as an agricultural resource has two dimensions. First, solar energy must be present for plant growth. Second, large amounts of energy are needed to carry out the increasingly mechanized functions of farming. Oil and natural gas are needed to run farm machinery. Natural gas is the raw material used for many commercial fertilizers.

Resources in the social system include people, policies, and practices. Land ownership, resource distribution, crop selection, and management decisions all affect production. Zoning laws, crop rotation patterns, pest management techniques, profit margins, and government subsidies all fit into the social system. They, too, help determine the quality and quantity of agricultural products just as certainly as the resources in the environmental system.

Land ownership is a very important component of the social system. It greatly influences a country's social or financial well-being. Ownership by corporations is usually characterized by large tracts of land organized to produce large quantities of relatively few products. In many cultures, small scale or family farms blend the economic necessities of making a living with concern for the land. However, many of these small family farms are not very productive and cannot compete successfully with larger agricultural businesses. This may mean that these small farmers are barely able to support their families. In severe cases, it can mean that the farms must be sold as

the farmers are forced to turn to more profitable ways of making a living.

Robert S. McNamara, past President of the World Bank, stated:

"As a generality small farmers in developing countries are among the lowest income groups in the society. Their agricultural productivity is often at bare subsistence levels. . . .

"For the small farmers who remain on their land, their only hope to escape poverty—with its poverty-related (human) fertility levels—is government policy deliberately designed to assist them to increase their productivity."

When the environmental system and the social system are not working well together the result is the loss of resources necessary to sustain agriculture and the loss of agricultural products themselves. Is there any evidence that the two systems do not always work well together? Unfortunately, this is often the case. Here are three examples:

1. In 1975 230 million **hectares** of land were irrigated. By 1990 irrigated land is projected to exceed 280 million hectares. Irrigation is used to supply water to areas where rainfall is too low to support crops. In some areas, crops which could not normally grow there will thrive if irrigation is used. The benefits can be great. However, problems are also associated with irrigation. Not only does irrigation require much energy, it can also damage both soil and plants. This damage occurs when the dissolved salts found in the water form concentrates, saturating the soil. These high levels of salts are toxic to the plants and are not easily removed from either the water which transports them or the soils in which they are deposited.

2. New strains of high yield grains have enabled farmers to produce more food on a given acre. However, these new grains require large amounts of chemical fertilizers, **herbicides**, and **pesticides.** These chemicals are becoming more and more expensive. Their application involves many environmental hazards. Also, these new strains of grain are genetically very closely related and therefore, are vulnerable to pests and disease. These kinds of plants have no range of tolerance. All react to climatic changes or disease in the same manner. If, for instance, an insect pest or disease were introduced to fields that were planted in the same strain of wheat, every field would react to the invasion in the same way. If the wheat were not tolerant to the disease or pest, field after field could be destroyed.

3. Another serious problem associated with intensive agriculture is **erosion.** It takes many years to create an inch of topsoil. However, in many areas, centuries of topsoil are washed or blown away each year because of poor farming practices. Without these nutrient-rich topsoils, the ability of lands to produce crops is greatly reduced.

Social systems must be able to respond to these environmental challenges. If not, we will have fewer options for producing food and other vital forms of agricultural products. How well we integrate and manage the resources in both the environmental and social systems will determine the future of agriculture.

Activity

Purpose: Analyze the following agricultural problems and determine ways to solve them.

Description: Listed below are five problems which affect the resources necessary for agriculture. First determine if each problem is more closely identified with social or environmental systems and pinpoint what might be most responsible for these conditions. Try to list at least two causes for each problem. Then determine how each system can be used or changed to solve each problem. Be innovative and creative in finding practical and realistic solutions. Suggest at least two ways that each problem might be solved.

- Compaction of soil
- Damage to crops from air and water pollution
- Uncertain or dwindling water supplies
- Extinction of certain strains of crops
- Conversion of croplands to urban areas

Making a Difference

If you live in an area where the climate makes gardening possible during the school year, plan and grow an organic garden. An organic garden is one which produces crops without the assistance of artificially synthesized chemicals. Try to find an outdoor garden plot that will meet your needs. If that is not possible, try to raise a few vegetable plants organically indoors. To make your garden more productive, you should consider starting a compost pile. Compost is a rich organic soil conditioner which will add substance and nutrients to your garden soil. Here's how to make a compost pile:

- Choose an out-of-the-way area that has a source of water nearby.
- Dig a pit .75 meter (2.5 feet) deep by one meter (3.3 feet) across or build a fence around a ground surface area about one meter square.
- Place leaves, grass clippings, and vegetable waste in loose layers. Between each layer add a thin layer of soil. Also add a starter of manure between some of the layers. This will start the composting process and keep the rate of decomposition rapid.
- If possible, cover the pile with straw to retain heat.
- Keep the compost pile moist and aerate it by turning the pile frequently so that all parts are thoroughly mixed.

If you manage the compost pile properly, no odor problems will develop.

To involve more people, create a community gardening program. Meet with community officials to see if land can be set aside for gardening plots. If a community-sponsored gardening program is already underway, try to influence as many people as possible to garden organically. You might help establish guidelines for starting and managing the gardens. If a community-sponsored program is not possible, your guidelines can still assist people who garden on plots which they have set aside privately.

Learning Aids

AUDIO/VISUAL AIDS

Conservation Down on the Farm. Produced and distributed by Stuart Finley, Inc., 3428 Mansfield Road, Falls Church, VA 22041. 16mm film; color/sound, 20 min., 1981.

Land Use: A Moral Dilemma. Produced by Maplewood Productions. Distributed by Environmental Film Service, 408 East Main, PO Box 855, League City, TX 77573. 16mm film; color/sound, 35 min., 1979.

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Go with the Flow

O farmers pray that your summers be wet and your winters clear.

— Virgil

Introduction

Water used to be a pretty simple subject. You either lived near a good source of drinking water or you didn't live. The demands for and uses of water have changed considerably over the years. Today water use is a complicated business. We can drink from a water fountain atop the Empire State Building. We can drill wells and build huge pivoting pipelines which transform dry areas into circles of fertile cropland. We can build massive dams to turn the river's energy into electricity and irrigate vast areas of desert.

Over the centuries, we have developed the ability to move water where we want it and to employ it in a thousand different ways. However, we haven't developed adequate methods of setting priorities to insure the best use of this limited resource. To paraphrase a quote by Ben Franklin, "We only seem to know the worth of water when the well is dry."

Projections from the *Global 2000 Report* indicate a 200 to 300 percent increase in the use of freshwater by the year 2000. Population growth alone will cause demands for water at least to double in nearly half the countries of the world in the period from 1971-2000.

By far the largest part of this overall increase is for **irrigation.** The increased use of water for irrigation is particularly significant since irrigation is a highly consumptive use. That is, much of the water withdrawn for this purpose is not available for immediate reuse because it evaporates, is given off to the air by plants, or becomes too salty. Also, irrigation is highly **energy-intensive:** large amounts of energy are needed to power irrigation pumps. Other major uses of water are for drinking; for bathing; for washing clothes, dishes, and cars; and for flushing toilets. Industry uses water for manufacturing and food processing. Power plants use it to generate electricity. Nuclear power plants and other industries use water for cooling purposes. Most of these domestic and industrial uses are not as consumptive as irrigation. For example, water used to cool a power plant can be returned to the river for reuse downstream.

But there are sometimes problems associated with these water uses, too. Even if the necessary *quantity* of water is available, it may not be of sufficient *quality* for its intended purpose. Pollution from industry, human sewage, and **agricultural run-off** may make water unfit for other uses. **Acid rain** caused by emissions from cars and from coal and oil-powered factories and power plants may make lakes and rivers too acidic to support fish and other aquatic life. Water may also become unfit for human consumption if it is the carrier of **waterborne diseases.** The creation of reservoirs and irrigation canals combined with the widespread lack of sewage treatment in many **less developed countries (LDCs)** has resulted in favorable conditions for the spread of a number of diseases. Schistosomiasis is now estimated to afflict 200 million people in 70 countries. Other diseases often transmitted by water include malaria, hepatitis, filariasis, yellow fever, cholera, typhoid fever, and amoebic and bacillary dysentery. These diseases are largely responsible for the high infant mortality rate in LDCs.

As summarized in the *Global 2000 Report:* "Freshwater, once an abundant

resource in most parts of the world, will become increasingly scarce in coming decades. First, will be a greater net consumption... so that total supply will decline. Second, pollution will effectively limit the uses of freshwater.... It seems inevitable that the functions of streams and rivers as habitat for aquatic life will steadily be sacrificed to the diversion of water for irrigation, for human consumption, and for power production.... "

Activity

Purpose: By playing the following WATER RESOURCES GAME, you will become immersed in a bit of history concerning water use and water-related problems. "Water Use" questions along the way will help you gain insight into our current water use patterns and the problems associated with those patterns. This information exchange may be a first step in forming the basis for sound decision-making about our future water use.

Description: The object of the WATER RESOURCES GAME is to travel through 70 centuries of water use to reach the year 2000 A.D. with more gallons of water than the other players.

1. Photocopy the Cutout Sheet; cut out all items; place action cards face down on the game board. Distribute 10 water cards to each player. Each card represents 100 gallons of water. Obtain a die.

2. You and three other students will start the first square (5000 B.C.) with 1000 gallons of water. Each player should select a small marker to move along the board.

3. As you roll the die, move the number of squares indicated. The square you land on determines whether you win or lose water cards depending on what was happening at that point in history.

4. You may also land on Action Squares. If you do land on an Action Square, draw a water use card from the pile in the center of the board. You then ask the player to your left the question printed on the card. If it is answered correctly, you must give the player two of your water cards. If it is answered incorrectly, you receive two cards from that player.

5. Play ends when a player reaches the year 2000 A.D. However, the winner is the player with the most water cards.

Making a Difference

As you played the WATER RESOURCES GAME, you saw a variety of current and historical uses for water. You also noted problems associated with water use patterns. Based on these observations you can make changes now to improve water resource use in your community.

Audit water use in your home. List all the ways water is used. Are some more necessary than others? Determine the amount of water your family uses in a month. You can do this by recording the number on your family's water meter on the first day of the month. On the last day of the month, again record the number on the water meter. Subtract the first reading from the second reading. Your answer will be the total number of gallons of water used by your family that month.

How could you reduce the amount of water used? For instance, is it feasible to install **flow restricters** in home showerheads or to place a timer near the shower to encourage quick showers? Simple actions like turning off the water while you brush your teeth can have a noticeable effect, particularly if practiced by the entire household. (It may be fun to calculate how much water you use in a month when doing small things like brushing your teeth. Record the water meter reading before and after you brush and multiply by the number of times you brush a month.)

After you have completed your audit and compiled your list, design a water conservation plan. Persuade your family to follow it for a month. (Keep in mind that you will have a better chance of obtaining their cooperation if you include them in the planning stages.) Record the water meter reading at the end of the second month and see if your plan did, in fact, make a difference!

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START

Roll die to see who goes first.

5000 BC
Irrigation widely practiced in Egypt in conjunction with yearly flooding of Nile.
Gain 2 Water Cards

250 BC
Archimedes invents the water screw—first efficient water pump.
Gain 1 Water Card

200 BC
Greeks construct first municipal water system with pressurized clay pipes and storage reservoirs.
Gain 2 Water Cards

ACTION SQUARE

100 AD
Pompeii builds efficient sewage system.
Gain 1 for efficiency
Lose 2 for timing

300 AD
Major water system in Rome supplies 60 million gallons per day.
Gain 2 Water Cards

ACTION SQUARE

1400 AD
Middle Ages—few significant improvements in water systems or treatment.
Lose 3 Water Cards

1845 AD
Major cholera outbreak in London from public well contaminated with sewage.
Lose 2 Water Cards

1897 AD
Yellow River floods killing one million people.
Lose 5 Water Cards

1897 AD
London begins to add chlorine to city water.
Gain 3 Water Cards

ACTION SQUARE

1933 AD
Drought and poor farming practices turn most of American Southwest into Dust Bowl.
Lose 3 Water Cards

1955 AD
Major hepatitis outbreak in India from city water contaminated with sewage.
Lose 3 Water Cards

1965 AD
Aswan Dam built in Egypt. Two million more acres of land placed in cultivation.
Gain 2 Water Cards

PLACE ACTION CARDS HERE

When you land on an Action Square draw an "Action Card" and ask the person on your left the question on it. If it is answered correctly, you must give the player two water cards. If it's answered incorrectly, you receive two water cards from that player.

OCEAN

Give ten water cards to each player and place the remainder of the cards here. If you lose all your water cards, you are out of the game. The winner is the person with the most water when a player first reaches the finish line.

1965 AD
Aswan Dam built in Egypt Thousands affected by water-borne schistosomiasis
Lose 2 Water Cards

1969 AD
Drought and resultant famine kill hundreds in Chad, Biafra, and other African countries.
Lose 4 Water Cards

1974 AD
Rain with same acid level as vinegar falls in Scotland.
Lose 2 Water Cards

1980 AD
World food crops reach record high. Irrigation important reason in many areas.
Gain 5 Water Cards

ACTION SQUARE

2000 AD
Irrigation systems widely used. Soils are waterlogged with high salt content. No fuel to run pumps.
Lose 5 Water Cards

FINISH

BEST COPY AVAILABLE

Created and designed by Earth People Associates © 1982, Zero Population Growth, Inc.

What use for water is expected to increase most by 2000? a. Domestic b. Energy Production c. Irrigation d. Industry (c.)	**True or False:** Water problems in the year 2000 will stem largely from uneven distribution and low quality rather than a global shortage. (True)	**True or False:** A leaky faucet can waste up to 40 gallons of water a day. (True)	100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
Which of the following is *not* a serious water related disease in the world today? a. Polio b. Schistosomiasis c. Typhoid d. Filariasis (a.)	**True or False:** Even a short shower uses more water than a bath. (False)	**True or False:** Salt buildup in irrigated soils is so severe that scientists are trying to breed plants that can grow in salt water. (True)	100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
The main cause of acid rain is: a. Auto exhausts b. Nuclear reactors c. Coal or oil-fired plants d. Increased use of wood stoves (c.)	**True or False:** Pollution is one of the biggest factors limiting the use of fresh water. (True)	**True or False:** Contamination of drinking water with sewage has not occurred since chemical treatment of water came into wide use. (False)	100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
Population growth will cause demand for water to: a. Double b. Triple c. Increase by 50% in nearly half of the world's countries by the year 2000. (a.)	**True or False:** Water used for irrigation usually runs back into the river to be used again. (False)	**True or False:** American Indians had extensive irrigation systems about 2000 years ago. (True)	100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
Which of these is *not* a significant factor in the spread of water-related diseases? a. Raw sewage flowing into irrigation ditches b. Creation of dams c. Lack of medical knowledge d. Poor sewage treatment (c.)	What percentage of water on earth is liquid fresh water? a. .6% b. 1% c. 10% d. 20% (a.)	**True or False:** Waterborne diseases are one of the main reasons for high infant mortality in many countries. (True)	100 gal.	100 gal.	100 gal.	100 gal.
			100 gal.	100 gal.	100 gal.	100 gal.
			Photocopy this page, cut out all items, and place action cards face down on the game board. Distribute water cards as indicated on the board.			

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11

Photo Forest

Holy Mother Earth,
the trees and all nature,
are witnesses of your
thoughts and deeds.

—Winnebago Indian saying

Introduction

You could think of a forest as a cradle which supports many varieties of plant and animal life. It also provides a stable structure for nonliving resources such as soil and water. The relationships between the elements that make up a forest are complex and are closely controlled by the amount and quality of sunlight, soil, air, minerals, and water available in this specialized environment. It is impossible to clear a forest without immediately destroying life and disrupting this order.

The clearing of forests--termed **deforestation**—is not a recent phenomenon. Have you read about the legendary cedars of Lebanon? They were destroyed around the time of King Solomon, leaving a desert where trees once stood.

Whenever forest clearing takes place, certain consequences occur. The chance of flooding increases because the extensive root system is no longer present to absorb heavy rainfall. Floods threaten human activity and welfare. Valuable topsoil is washed away, choking streams, reservoirs, and **irrigation** facilities. Loss of the nutrient-rich soil decreases productivity. This results in limited growth of trees, grasses, and other vegetation. Plant and animal diversity is lost, too, because the **habitat** is destroyed.

Trees and other forest vegetation normally absorb carbon dioxide from the air. In turn they give off oxygen. This natural exchange of gases helps to stabilize the Earth's atmosphere and climate. However, many scientists are concerned that heavy deforestation and the related decrease in carbon dioxide intake by plants will upset the balance. They claim that a worldwide warming trend will occur, changing today's crop patterns, melting the Antarctic ice cap, raising the sea level, and altering the coastline. This in turn will affect the human food supply and will especially affect people in the heavily populated coastal areas of the world.

Deforestation on a much larger scale than experienced in Lebanon in King Solomon's time is taking place now, particularly in South Asia, the Amazon region, and central Africa. Surprisingly, lumber acquisition is not the principal reason for most deforestation. Clearing of land for agricultural use and gathering of wood for domestic fuel outrank lumbering as the prime cause.

A recent example of one of the most extensive forest clearing projects of our time took place in the Amazon basin of Brazil. In 1967 American billionaire Daniel Ludwig bought 5600 square miles of tropical rain forest—the largest privately-owned tract in the world! Ludwig envisioned a huge money-making settlement which he named Jari. The planned products from this settlement were to be rice, pulp timber, and kaolin (a fine white clay used in making paper). To support these projects he built towns, factories,

and an extensive transportation system. Loggers cut and burned millions of tons of original forest and replanted it with trees from other parts of the world.

Today, much of this project is abandoned and Jari is for sale. The balance of this fragile area was destroyed, partially through the deforestation process itself and finally through unwise selection of vegetation used to replace the original plants.

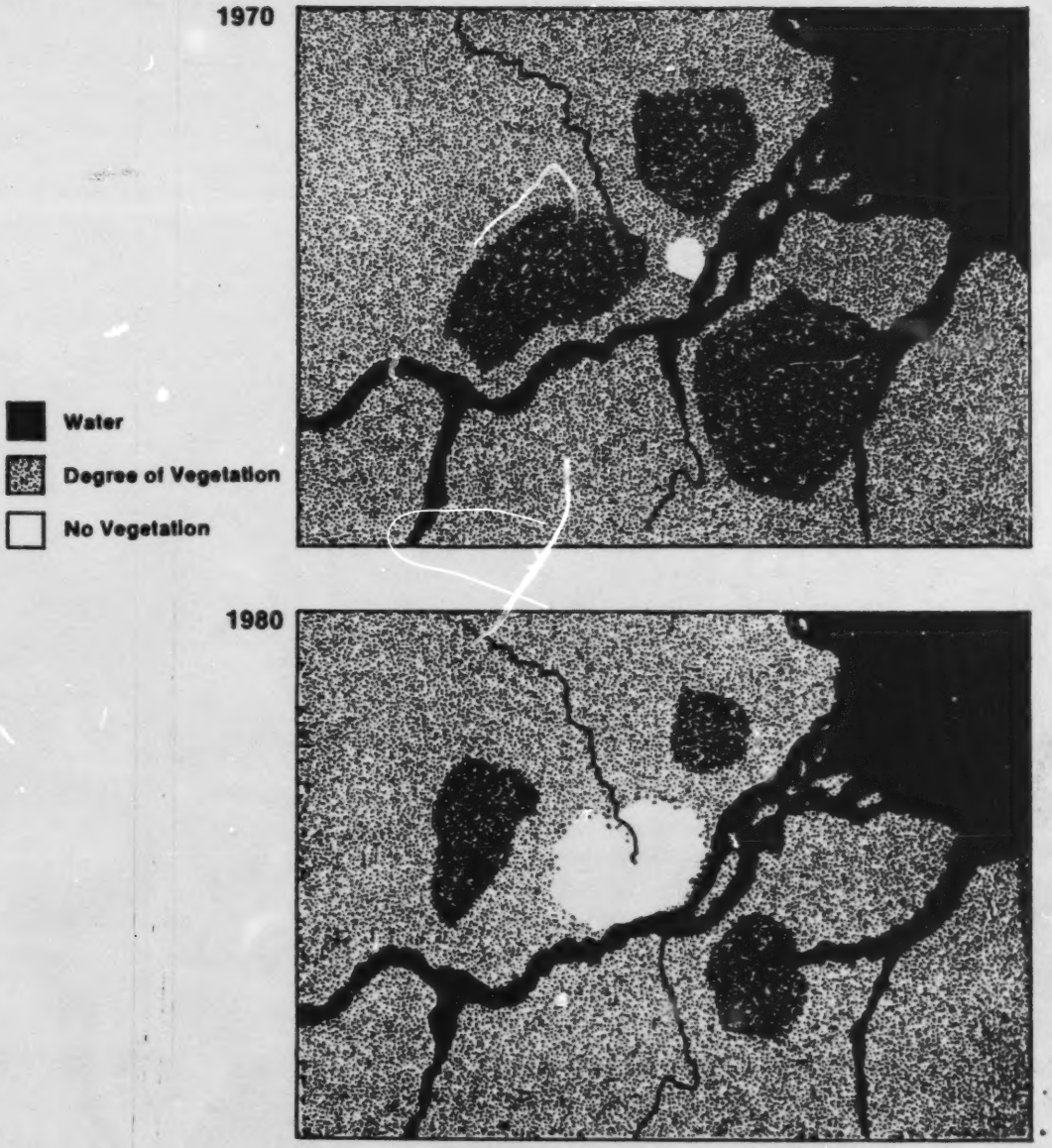
How many Jaris can we afford? When will we begin to regard forests as critical and valued natural resources?

Activity

Purpose: Through the examination of simulated satellite photographs, you will determine the extent of deforestation which has occurred in a selected area over a 10 year period.

Description: Would you be alarmed if the healthy trees in your backyard suddenly turned red? That's the way they appear in a Landsat infrared photograph.

Space age technology provides more than a bird's-eye view of the Earth. Images are transmitted by a Landsat satellite, which records the same point on the Earth's surface at the same time of day, at 18 day intervals. The satellite orbits the Earth at an altitude of 920



kilometers (about 570) miles. It provides data which have been helpful in such fields as geology, geography, marine resources analysis, agriculture, forestry, and land management. Because the Landsat can "photograph" the same area at regular intervals, it has become valuable in revealing changes in an area's vegetation, showing urban buildup, and spotting **erosion** problems.

Here are two drawings which depict the kinds of images that you might see in a Landsat photo. Use the accompanying key to help you interpret the symbols for important features of the area. In actual Landsat photos, features such as vegetation, water, and mineral deposits appear in vivid colors.

Assume that these two "photos" depict an area of South America. From the symbols and legend, try to guess which country or region of South America is represented. Next, from the changes in patterns, try to interpret what might be taking place. Notice the dates of the photos, which may also provide a clue. Finally, try to calculate roughly how much area is affected. Summarize your analysis in a report and present it to your classmates and teacher. Did they reach different conclusions?

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Making a Difference

Converting a woodlot or a field in your community into a housing project or parking lot is not on the same scale as clearing a tropical forest. However, it still results in environmental disruption. Identify a nearby wooded area which is scheduled for development. You may learn of potential development sites through notices of rezoning hearings. Often, these notices are required to be posted on the specific property to be developed. City or county documents are also good sources for information about new land projects.

After you have chosen a site, you may wish to contact the developer of the property by letter. In your letter, explain that you are working on a project for school. Let the developer know you are interested in the steps the firm will take to prevent unnecessary soil erosion and **sedimentation.** Ask permission to explore and photograph the site during various stages of development. Be sure to ask when you may visit the site. Assure the developer you will give notice each time you wish to visit.

Here are some ideas to help you determine measures that might assist soil conservation on the site.

1. Become familiar with the basic techniques of soil conservation through library research. Examples of soil conservation techniques you might study are **contouring,** minimum clearing of vegetation, and planting a fast-growing grass cover.
2. If possible meet with a soil conservationist or a forester. Perhaps the expert can even visit the site with you to provide additional background on soil conservation techniques appropriate for that particular site. Conservation measures may differ depending on the development site.
3. Obtain the pamphlets listed in the Learning Aids section of this unit and study them carefully.
4. Check to see if any laws regulate developers' treatment of the land during construction. The city or county attorney should be helpful.
5. The developer might already be planning some protective measures. Be sure to ask. If the developer has plans, request to review them as part of your learning experience.
6. If the developer has no plans in mind, offer to send a checklist of erosion control measures you've developed from your research and discussions with the soil conservationist or forester. Be sure your checklist is appropriate for the type of area being developed.
7. If the developer is interested in learning more, refer him or her to the soil conservationist in your area.
8. Remember, you will be more successful if you cooperate with the developer.

Monitor the development of the site at regular intervals. Photograph positive measures the developer has taken as

50

100

well as things which have been left undone. Note the date and exact location of each photograph and create a pictorial essay which you can present to your teacher. Be sure to go through the checklist with him or her to show which measures were taken by the development firm and which you feel could have been taken.

Then report back in person to the developer, or draft a letter outlining your findings. You might include photos or illustrations with your report. Be sure to label and explain them. The conservationist and city/county land management official also may be interested in seeing a copy of your letter.

Learning Aids

AUDIO/VISUAL AIDS

Mud. Produced and distributed by Stuart Finley, Inc., 3428 Mansfield Road, Falls Church, VA 22041. 16mm film; color/sound, 23 min., 1968.

PRINTED AIDS

A Conservation Plan . . . for a Developing Area, U.S. Soil Conservation Service, PO Box 2890, Washington, DC 20013.*

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Tree Talk: The People and Politics of Timber, Ray Raphael. Island Press, Covelo, CA, 1981.

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*Learning Aids to order for use in this unit.

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Build a Better Smokestack

Ill blows the wind
that profits nobody.

— John Haywood's Proverbs

Introduction

Who owns the wind? Nobody of course, but there are those who wish the countries that "borrow" a bit of the wind to use for awhile would take better care of it. Using winds to disperse air pollutants is an easy, but perhaps short-sighted solution to a major problem.

The smokestack is one of the most easily recognized symbols of our society. Factories produce steel, copper wire, cars, and thousands more machined items necessary to maintain our standard of living. These factories and power plants burn oil and coal, producing large quantities of pollutants—tons of fly ash (the small particles that make smoke black), sulfur dioxide, and oxides of nitrogen.

For years the solution to disposing of these unwanted by-products of progress was to build taller smokestacks. With tall smokestacks, the pollutants were dispersed by the wind and were no longer a problem—or so people thought. The tall smokestacks equipped with devices to filter the fly ash did solve the problem in the local area. People living near power plants and factories had fewer complaints. However, the old adage that "what goes up must come down" is true even for gases like sulfur dioxide. The winds may carry sulfur dioxide for hundreds of miles, but eventually it combines with water in the atmosphere to form sulfuric acid (the same acid used in car batteries). A similar process results in the production of nitric acid when the oxides of nitrogen combine with water in the air. When these atmospheric acids are washed from the sky during storms, **acid rain** is produced. (Actually, "acid precipitation" is a more correct term. You can also have acid snow or hail.)

The amount of acid that something contains is normally measured on a scale from 1 to 14. The lower the number, the more acidic the substance is. This "acid rating" is known as the **pH.** The normal pH of rain is 5.7. Yet rains over large parts of Sweden, Norway, eastern Canada, and eastern United States now have a pH of 4.3. In one extreme case, a 1974 rainstorm in Scotland had a pH of 2.4—the same pH as vinegar!

Most plants and animals can exist only in a narrow pH range. If a lake or river becomes too acidic, the fish and aquatic insects that live there die. A survey of 1500 lakes in Norway showed that over 70 percent of the lakes with a pH of 4.3 contained no fish. Only 10 percent of the lakes with a normal pH of 5.5 to 6.0 had no fish. Similar findings have been noted in lakes in the Adirondack Mountains of New York.

Although the death of sensitive fish such as bass and trout is the most easily seen effect of acid rain, there are many other noticeable problems. The small

organisms such as bacteria, which normally break down dead material on lake bottoms, have been found to be adversely affected by acid rain. This upsets the normal process of decay and **nutrient recycling**. At times organisms that are more resistant to acidic conditions can survive and, without the normal competition, even flourish. For example, several species of small flies in certain Minnesota lakes have become more numerous than usual. They are able to tolerate the acidic conditions better than many other insects. In a like manner, some aquatic plants are killed while acid-tolerant species ..., do well. Their presence indicates that the delicate balance of the aquatic **habitat** has been drastically disturbed.

The effects of acid rain on plants such as trees and crops is less well known. Experiments with soybeans and radishes have shown that conditions similar to acid rain stunt growth. There is a strong possibility that the growth of major forests in eastern North America is being slowed by acid rain. The acid rain may also weaken trees and other plants so that they are less resistant to disease.

Acid rain also dissolves limestone. Statues, building stone, even tombstones are being eaten away by acid rain.

The overall extent of the acid rain problem is still being explored. The degree of future problems is largely unknown. However, we do know that most of the sulfur dioxide and oxides of nitrogen in the air come from burning fossil fuels. With the projected increase in the use of coal and, to a lesser extent, oil, it is likely that large areas will continue to receive acid rainfall. While the technology exists to remove sulfur dioxide from smoke, the removal of oxides of nitrogen is more difficult and costly.

Activity

Purpose: The following activity will allow you to investigate causes and indicators of acid rain. By analyzing data, conducting library research, and participating in a simulated public meeting you will be able to see the effects of acid rain and propose solutions to this problem.

Description: You are the mayor of a small town in the Adirondack Mountains of New York. A citizens' action group has recently completed an analysis of a nearby lake and presented you with its findings: *pH of lake*—4.4. *Organisms collected*—large numbers of fly larvae, mayflies, water striders, and a few minnows and suckers. No trout, frogs or salamanders were found. *Appearance of lake*—water clear, but large mats of algae and certain other aquatic plants present.

After seeing the results of this study, you have decided to hold a public hearing on the acid rain issue to see how it affects your town. You have invited the following people to testify: the president of a steel firm in Cleveland, Ohio; the president of the citizens' group which conducted the lake analysis; and the president of the local Chamber of Commerce. (Ask other students in your class to assume these roles.) You have directed these people to address the following points in their presentations.

Steel company president:

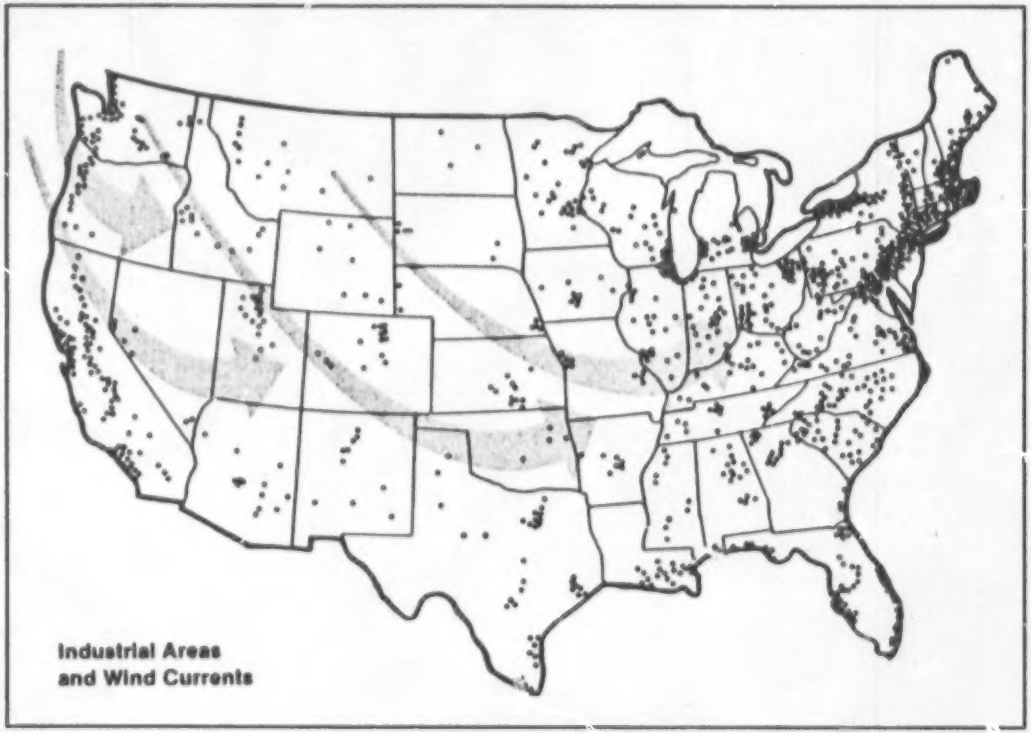
- The need for steel and products from other heavy industry; the number of jobs that result, etc.
- The expense of air pollution controls
- The variability of air currents and the difficulty in determining which factories are causing acid rain

President of the citizens' action group:

- The results of the survey
- The affect of acid rain on trees and wildlife
- The probable source of acid rainfall in the Adirondacks (Use the following map showing wind currents and industrial areas.)

President of the local Chamber of Commerce:

- The importance of sport fishing to the local economy
- The effects of acid rain on the buildings and monuments in town
- The importance of the timber industry to the town and the long term effects acid rain might have on trees



Industrial Areas and Wind Currents

Give each presenter time to research the points that need to be covered. (A week should be adequate.) Encourage the presenters to use charts and posters to make their points. At the same time you need to do research so that you can conduct the public meeting. When everyone is ready, hold the public meeting in front of the class. Ask each presenter questions based on your research and encourage other class members to ask questions also.

After all the testimony has been given, prepare a report which summarizes the problems and recommends solutions. (Remember, you can't just build a better smokestack!) Your report can be a three page written plan or oral report to the rest of the class.

Making a Difference

The situation with which you worked in the activity is hypothetical, but the problem is real. Acid rain may actually be causing damage in your area. One way to discover whether or not it is a problem is to test rain water or water from local lakes. The pH should be about 5.7. If it is much lower than that, local vegetation and wildlife may be seriously affected. There are a variety of kits available that can be used to test the pH of streams and lakes. You may be able to borrow water testing kits from your school or from a government agency such as the

Soil Conservation Service, U.S. Forest Service, or your state fish and game agency. Simpler kits can also be purchased at pet stores, and pH paper can be ordered through scientific supply houses. (Check with your chemistry or biology teachers.)

If you find that your area does have an acid rain problem, perhaps you can use some of the ideas you developed in this activity to help solve it. Even if your area isn't currently experiencing the effects of acid rain, you may want to write letters to your elected officials to tell them how you feel about it and to recommend that your area be protected from acid rain in the future. You should address your letters as follows:

The Honorable_____ Dear Senator _____:
U.S. Senate
Washington, DC 20510

The Honorable_____ Dear Representative _____:
U.S. House of Representatives
Washington, DC 20515

The President Dear Mr. President:
The White House
Washington, DC 20500

You can also write to your state, county, and local officials or submit an article on your findings or an editorial stating your opinion to your school or local newspaper.

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Learning Aids

AUDIO/VISUAL AIDS

Acid from Heaven. Produced and distributed by National Film Board of Canada, 111 E. Wacker Drive, Chicago, IL 60601. 16mm film; color/sound, 30 min., 1981.

PRINTED AIDS

"Acid Rain," G.E. Likens. **Environment,** 14, March, 1972.

"Carbon Dioxide and Climate Change: An Agricultural Perspective," S.H. Wittwer. **Journal of Soil and Water Conservation,** May/June, 1980.

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New Clear Reactions

Some of the by-products of reactors, it should be noted, have half-lives approximately five times as long as the period of recorded history.

— Global 2000 Report to the President

Introduction

By the year 2000, the so-called Atomic Age's initial impact will have been felt. The world was starkly awakened to the awesome and destructive effects of nuclear energy in the mid-1940s when the atomic bomb ended a war and the Japanese Empire

During the decades following World War II, attempts to "tame the atom" and develop its peaceful uses were thought to be a way of building a new empire—an energy empire. All has not gone as planned, but nuclear energy has played an increasingly active role in helping to supply the energy demands of the Earth's people.

The **developed countries (DCs)** became developed through the use of energy. Fossil fuels—coal, natural gas, and oil—have been used extensively to improve industrial, technological, and domestic life in these countries. As energy demands have grown, fossil fuel supplies have shrunk. Many DCs have turned to other countries, particularly those in the Middle East, to meet their energy needs.

Sometimes dependence invites conflict. For instance if one country depends on fossil fuels supplied by another country and the supply is reduced or cut off, there is a conflict. To reduce that dependence and also the chance for conflict, the development of new and different energy sources began. Nuclear energy was one of these.

But nuclear energy presents its own problems and risks. First there is a supply problem. High grade uranium used for fuel is not plentiful. Most of the uranium ore will probably be used up by the early part of the 21st century. The problem of fuel shortages for nuclear reactors may be partially overcome by the proposed development of **breeder reactors.** This new type of reactor actually produces more fuel than it spends. A major drawback, however, is that breeders convert uranium to plutonium. Since plutonium is the element used in atomic weapons, the chances for theft or terrorist actions are increased.

There are also economic considerations. Building costs are rising so rapidly that few companies can afford to build a nuclear plant. A modern nuclear power plant must operate 10 years to generate enough profit to pay the high cost of building it. In the 1970s, only two percent of the world's entire energy demand was satisfied by nuclear sources. It is no wonder the development of nuclear energy has not been more rapid.

To date, the production of nuclear power continues to carry many environmental risks. Uranium mining and processing produce millions of tons of low-level **radioactive waste.** Nuclear power plant operation creates further waste. Yet we have not found any means of treating or storing these wastes effectively or safely. Furthermore, power plant operations are subject to human errors in safety procedures and to uncontrollable forces such as earthquakes. A release of radioactive material into the environment from a nuclear accident could contaminate large quantities of air, water, and other resources basic to human survival. People exposed to radiation often show increased evidence of cancer and their children have more birth defects.

Deliberate sabotage of power plants by terrorists as well as theft of nuclear fuel for use in atomic bombs pose grave threats to world peace. The continued development of nuclear weapons adds to world tensions. Of course, unleashing these weapons would have disastrous effects.

However large or small the role of nuclear energy, it is and will continue to be a source of energy as the world enters the 21st century. According to the *Global 2000 Report*, we will rely on nuclear energy more in 2000 than we do now. Nuclear energy is important because of its potential good and potential harm. The following activity will provide the opportunity to explore both these potentials.

Activity

Purpose: By constructing and conducting a game, you will learn about nuclear energy and its impacts.

Description: Plans for a GLOBAL 2000 NUCLEAR ENERGY GAME are provided. You will be responsible for constructing the game according to the following instructions in order to play it.

Materials Needed:
- 40 to 50 3" x 5" unlined file cards
- felt tip pens
- 20" x 30" piece of heavy poster board (plain or colored)
- one pair of dice
- game board marker for each player

Number of Players: For a playing time of 15 minutes, four students will need to participate. More students may join the game if a longer playing time is desired.

Game Development Directions: You may work by yourself or invite one other person to help you. Develop the game according to the following directions:
1. Enlarge the diagram of the game board provided in this unit to fit the 20" x 30" poster board.
2. Supply enough markers for the number of people who will be playing.
3. Copy the following True-False sample questions on 3" x 5" cards (EXCLUDING THE ANSWERS!). Research and develop an additional 12 True-False questions and place each question on a separate 3" x 5" card. The front of each True-False card should be marked with a yellow-colored atom symbol.

Sample True-False Questions:
- The United States uses more energy per person than any other nation in the world. (T)
- The heat produced in a nuclear power plant is used to boil water. (T)
- Uranium is considered to be an expensive fuel source. (F)
- North America has about 40% of the uranium reserves of the free world. (T)

4. Prepare a master list of correct answers which correspond to the True-False questions. These answers will be used as references while playing the game. The list should *not* be circulated to the players in advance.
5. Place all True-False (yellow atom) cards in one pile.
6. Repeat steps 3 and 5 for action cards. These will be represented by a red atom symbol.

Sample Action Cards:
- Move to alternate source space. (Make one card for each alternate source indicated on the spaces, six altogether.) Example: Move to geothermal energy; move to hydro energy; etc.
- Plutonium reported stolen. Stay where you are for one turn while investigation is conducted. Then proceed with caution.
- You discover safe and satisfactory way to process and dispose of radioactive wastes. Move ahead six spaces.
- Nuclear missile was accidentally fired. Go back four spaces.
- United Nations has adopted a successful plan for energy conservation. Move ahead three spaces.

Note—The cards you make should:
a. *Be challenging* but not too difficult for the players.
b. *Contain logical actions.* For instance, statements which describe potentially harmful impacts should be coupled with directions to move back on the board.
c. *Be accurate.* Be sure you check the facts on your cards with at least two different references.

Continued on back

Nuclear Energy Game

= Yellow card is drawn and read here.

= Red card is drawn and read here.

FINISH

WOOD

BIOMASS

TIDAL

SOLAR

WIND

GEO-THERMAL

START

BEST COPY AVAILABLE

Adapted from *Ranger Rick's Nature Magazine*, © September, 1981, The National Wildlife Federation

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Remember, in order for the game to have maximum educational value, you must be prepared to know the correct answers to the True-False questions on the atom cards, and you must be willing to share the information or explanation if the players answer incorrectly. If you don't, this will be only a game of chance and the educational value will be minimal.

Learn the rules, then invite your classmates, your teacher, or others to play.

Procedures and Rules of Play:

1. Each player should select a marker to represent him or her on the game board.
2. Each player rolls the dice to determine who goes first. Highest roll goes first; other values follow in descending order. Those rolling the same value on the dice should roll again to break the tie.
3. To begin a play, each player throws the dice and moves the number of spaces indicated on the roll.
4. After everyone's first turn, players should advance according to the value indicated by rolling only one die.
5. If players land on an alternate source space, they get an extra roll of the die.
6. If players land on a red atom space, they draw a red atom card from the pile. Players must do what the card directs (either move forward or move back, stay on the square, etc.).
7. If players land on a yellow atom square, they draw from the pile of yellow atom cards and read the card aloud. If the players answer correctly, they move forward five spaces. If the answer given is wrong, players must move back three spaces.
8. If players land on an arrow square, they must move in the direction the arrow indicates and await their next turn.
9. The first player to cross the finish line is the winner.

Making a Difference

World opinion is often formed from collections of local opinions. Investigate what people in your own community think about nuclear energy.

Conduct a survey of your class or schoolmates to discover their reactions to the idea of constructing a nuclear power plant near your city or town. If your community already has a nuclear power plant, find out the attitudes of your friends and fellow townspeople about this specific plant. The survey can be conducted in your school, in a shopping center, or on the street.

In order to conduct the survey, develop a short, unbiased questionnaire. You might want to include questions about:

- The cost of building and operating a plant. Would people be willing to pay more on their monthly electric bill?
- The effect of the nuclear power plant on the local economy. Would it attract new industries to the area and create new jobs or would people move away because of it?
- The environmental and health considerations. Do you think that safety would be adequately considered if a plant were designed and built?
- The consequences of a nuclear accident. How would *your* community be affected?
- Migratory patterns. Do you think people would move into your town because of the plant? Move out? Or would the plant have little effect on people's movements?

Learning Aids

AUDIO/VISUAL AIDS

The Breeder. Produced and distributed by Stuart Finley, Inc., 3428 Mansfield Road, Falls Church, VA 22041. 16mm film; color/sound, 23 min., 1978.

PRINTED AIDS

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Bye Bye Birdie

Human beings, in their quest for economic development or the riches of nature, must come to terms with the reality of resource limitations and the carrying capacities of ecosystems, and must take account of the needs of future generations. This is the message of conservation. For if the object of development is to provide for social and economic welfare, the object of conservation is to ensure Earth's capacity to sustain development and to support all life.

—From the Preamble to the *World Conservation Strategy* prepared by the World Wildlife Fund and the International Union for Conservation of Nature and Natural Resources.

*Title used by permission of Charles Strouse, Lee Adams, and Michael Stewart, copyright proprietors of the musical play of the same title.

Introduction

An estimate prepared for the *Global 2000 Report* suggests that 15 to 20 percent of all species on Earth could be extinguished by 2000. Much of the loss will occur in tropical forests where clearing of the forests for farming will eliminate thousands of species of insects, other small organisms, and plants. Many of these organisms have never been classified or examined by scientists. Current trends indicate that many aquatic species are threatened. Damming, **acid rain, pesticides, siltation,** and toxic chemicals will all take a severe toll by the year 2000.

Some people point to the dinosaurs as proof that **extinction** is a natural process and that people's concerns today are overstated. However, the extinction of most dinosaurs was a gradual process occurring over millions of years. This does not parallel today's situation. It is estimated that three species of life were lost *every day* in 1980 and that a loss of one species *per hour* is likely by the year 2000. Many reasons have been proposed for the final mass extinction of the dinosaurs, but of one thing we can be certain: unlike today's situation, humans were not responsible for the loss of the species of dinosaurs.

What will we lose if these plants and animals become extinct? Some of these losses are rather abstract, such as the loss of beauty when a rare butterfly or sleek leopard becomes extinct. However, we also stand to lose much more than this if some plant and animal species are allowed to become extinct.

If preserved and carefully managed, many species could become new sources of food, medicine, chemicals, or a variety of other products. As James L. Buckley noted, "What good is a snail darter? As practical men measure 'good' probably none. But we simply don't know. What value would they have placed on the cowpox virus before Jenner; or on a *penicillium* mold (other than those inhabiting blue cheese) before Fleming; or in wild rubber trees before Goodyear learned to vulcanize their sap? Yet the life of almost every American is profoundly different because of these species."

Some of the most important losses will involve the extinction of cereal grains. Eighty percent of the world's food supply comes from about two dozen kinds of plants and animals! Wild strains are needed for breeding pest and disease resistance into the high yield (but often highly susceptible) plant varieties now widely used. Corn provides a good example of this problem. Recently a major outbreak of blight spread throughout the American Midwest. Since most of the corn varieties being planted were genetically similar, all were affected by the disease. Our lives will be greatly influence by our actions—and inactions—regarding species extinctions.

Activity

Purpose: The following activity allows you to explore some of the tough questions concerning species preservation. This exercise allows you the opportunity to "practice" or "simulate" what may one day become a very real situation. By examining the value and desirability of a number of species, you should be able to develop a better understanding of the complex problems we face in this area.

Description: As the following item from their *1979-80 Annual Report* indicates, the World Wildlife Fund has invested thousands of dollars in a project designed to examine benefits and set priorities for preservation of species.

Mankind is now precipitating the extinction of large numbers of animals, birds, insects and plants. Of the earth's 5 to 10 million species, we may lose at least one million by the end of the century and a good many more within the following decades. We are probably already losing one species per day, and by the end of the 1980's, this could mount to one per hour. Yet scientists believe many of these very species carry untold potential benefits for the health and economic stability of the world. Given the limitations of conservation funding, tough choices are probably going to have to be made. Which of these species might assist in curing cancer or in relieving world hunger? Which ones can we save? This project will seek a systematic method for the comparative evaluation of species and provide guidelines and techniques for conservationists for setting priorities.

In the following activity, you have been appointed to investigate this issue. (You can conduct your investigation alone or ask two classmates to form a team.) You will have two tasks:

1. First, you must determine which factors should be considered before a decision is made to save a species or let it become extinct. You should list each reason you think is important and write a one paragraph defense of each argument.

2. In the second part of the activity, you will apply the criteria you developed.

Have members of the class "adopt" one or two of the species listed on the Data Sheet. Give them time to research information about their species in the library. They should prepare a short presentation which describes the species, states its importance, and gives reasons why it should be preserved. (Note: students may not be able to find reference to the Melones Cave Harvestman or the Prairie Skipper Butterfly in the library, but should be able to find information on harvestmen and skippers in general.)

Have the students give their presentations to you (and your two classmates if you're working as a team). As the presentations are made, rate each species using the criteria you developed in the first part of the activity. As the final part of the activity you must decide which species you will "save" and why. Your decision can be discussed in a two page written report or a five minute oral presentation to the class. Your analysis should focus on the relative possibility of success, examine the economic value of the species, and include less concrete factors such as the preservation or loss of beauty.

Making a Difference

You can easily expand this activity to examine how your personal feelings affected your decisions. Would your recommendations have been different if you had been a member of a delegation from China? Ask several of your friends to conduct this activity while representing different countries. Then, meet with them and try to decide on a single course of action to preserve endangered species. You might also pick a single species and examine what steps might be taken now to head off the problem the species faces in 2000.

There are also some things you can do in your community. You might write to the

U.S. Fish and Wildlife Service or your state fish and game agency to obtain a list of threatened or endangered species in your area. A check with a nearby nature center or natural history museum might also provide helpful information. Once you know which species are endangered in your area, you can research whether or not any efforts are being taken to protect the endangered animals or plants. Local clubs or organizations may already be at work to protect some species. You may be able to encourage additional projects through your school, scouts, 4-H, nature clubs, or hunting and fishing clubs.

Learning Aids

AUDIO/VISUAL AIDS

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Species Extinctions

DATA SHEET*

1. HAWKSBILL SEA TURTLE

Rapidly disappearing hawksbill turtles are the primary source of tortoise shell jewelry. The turtles are killed for their shells and their eggs are frequently dug up by predators or by people. In addition, the sandy beaches where the turtles nest are threatened by resort development and pollution.

2. BALD EAGLE

The bald eagle is currently holding its own in the United States. However, the threat from pesticides which can kill eagles outright or cause them to lay thin-shelled eggs is a source of concern. The bald eagle is the national symbol of the United States and is an important religious symbol to some Indian tribes.

3. WILD PERENNIAL CORN

In 1979 a wild variety of corn was discovered in the mountains of Mexico. Plant scientists theorize that crossbreeding this wild variety with cultivated corn could produce a variety which grows like grass—coming up every year without being replanted each spring. However, the Mexican mountain habitat of the newly-discovered corn is rapidly being destroyed by lumbering and the intrusion of people and goats.

4. MELONES CAVE HARVESTMAN

This rare "daddy long legs" is known to live in only two caves in California, both in areas which were targeted for development. Human visits to the caves are also frequent and increasing, posing an additional threat to the survival of the species.

5. PRAIRIE SKIPPER BUTTERFLY

These extremely rare and beautiful butterflies survive in scattered remnants of the once-vast prairies of the midwestern United States. Now these prairie areas are largely converted to corn and wheat fields. Because of its loss of habitat, the butterfly is faced with extinction.

6. SIBERIAN CRANE

Fewer than 340 Siberian cranes now survive in Asia where thousands flocked in the early 1960s. Although the cranes' arctic breeding grounds in the Soviet Union are strictly protected, little is known about their migration routes. Their wintering grounds in China, India, and Iran have largely been converted to agricultural use. Warfare in Afghanistan, revolution in Iran, and a 1979 drought in India have taken a heavy toll.

7. GRAY WHALE

The 6000 mile migration route of the Pacific gray whale is threatened by increasing pressure from energy development, shipping and pollution at sea, and by commercial development in and around breeding lagoons.

8. ASIAN TIGER

At one time the tiger ranged from Siberia to the depths of Asian jungles. Today, however, very few of these huge cats remain. Many tigers are killed each year for sport and to prevent loss of livestock. Clearing areas of jungle for farming has also contributed to the decline.

*Some species descriptions based on the *1979-80 World Wildlife Fund-U.S. Annual Report*